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EMERGENCY BULLETIN!

State Crop Pest Commission
OF LOUISIANA.

CIRCULAR NO. 15. June, 1907.

The Circulars of the State Crop Pest Commission are sent free of charge to all farmers and fruit growers of Louisiana who make application therefor.

FIGHTING THE BOLL WEEVIL BY PICKING UP THE INFESTED SQUARES.

BY WILMON NEWELL.

The farmer in the boll weevil infested section of the State is now casting about for every possible means by which he may protect his cotton crop—already severely handicapped by the bad season—against the attacks of the boll weevil.

Paris green has not proved to be the panacea that some anticipated, for what little good it might have done has been prevented by the heavy rains, which washed off applications as fast as they could be made. Those who pinned their faith to it are now more than ever discouraged, having added the cost of the poison and of the labor involved to their already too heavy load.

The present article is intended to call the farmers' attention to a method of fighting the boll weevil which was quite extensively practiced in Texas a few years ago, and which, under the present peculiar seasonal conditions in Louisiana, we believe

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to be of value. This plan consists in gathering up the fallen infested squares in the cotton fields once every seven or eight days and burning them, or confining them so the weevils that hatch from them cannot escape. Many Texas farmers secured increased yields by using this method, but in the past we have hesitated about recommending it to the Louisiana planters on account of plantation labor in this State being so scarce and high. We have preferred, in the normal season, to pin our faith exclusively to the cultural methods and to the making of a crop ahead of the boll weevils. An early crop the present season is out of the question; the farmer already has his money invested in the seed, fertilizer and first cultivations, and if his crop be abandoned now, or turned over to the boll weevils, which is about the same thing, everything invested will be lost. On the other hand, if he can go to a little more trouble in protecting his crop against the weevils, the partial crop made will lessen his loss by that much. Hence we believe the present circumstances are such as to justify the planters in adopting the plan of picking up the infested squares.

In much of the boll weevil territory the only possibility of making a crop lies in the application of the measures herein recommended and in taking precautions against the boll worm, to which reference is made below. It is perhaps needless to add that at the same time, the crop should be cultivated often and thoroughly, shallow cultivations being made as often as possible.

The adult weevils which hibernated through the winter are now dying off very rapidly, and in the latter part of this month and early in July adult boll weevils will be much scarcer than they are now. The planter should not let this lull him into a false sense of security or into the belief that the boll weevils are disappearing. IT WILL BE NOTHING MORE THAN THE PERIOD DURING WHICH HUNDREDS OF THOUSANDS OF YOUNG WEEVILS WILL BE DEVELOPING IN THE FALLEN SQUARES, to result in the "first sum-

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mer brood'' of adult weevils about the middle of July. It is this summer brood of which the planter is in greatest danger, for if this brood be abundant enough to destroy all squares as fast as formed all chance of making a crop will be gone.

Our advice to the planters is to begin, as soon as most of the plants are squaring, picking up the fallen squares each week and either burning them, or enclosing them in a tight wire cloth cage, preferably the latter. We have found that there are a good many little wasp-like parasites attacking the weevils in different parts of the State, and the farmer should do everything he can to encourage the increase of these parasites, as they are most important and valuable allies in the fight. If the gathered squares be burned up, the parasites which are developing within them will also be destroyed. What we want to do is destroy the boll weevils which will hatch from the squares, and at the same time allow the parasites that are in along with them to mature and get back to the cotton fields where their progeny will destroy more boll weevils. If the gathered squares, instead of being burned, are placed in a tight outdoor cage, made of ordinary wire cloth or screening, the boll weevils that emerge will be confined and will finally die of starvation. The little parasites that issue from the same squares can, however, escape through the meshes of the wire cloth and return to the cotton fields. This is a very important point, and the farmers now have an opportunity to aid the Commission and the Bureau of Entomology in their efforts to increase the natural enemies of the boll weevil. Therefore, put up the gathered squares in screen cages if you can possibly take the time to do so, and burn them only as a last resort. Of course, it is better to burn them than to allow weevils to escape.

The price and availability of labor are two important things to be taken into consideration in deciding whether this plan of gathering the infested squares will be profitable on any particular farm. One to two dollars a day for adult laborers to do this work is almost too high, but if either white or negro children can be employed at a low price to gather the squares, there is little doubt of its proving a profitable undertaking.

There will, of course, come a time, probably in early August, when the squares will fall too fast to permit further profit from gathering them. The writer's opinion is that on most farms the gathering of squares can be continued with profit until the last week in July.

SUMMARY.

1. Gather the fallen infested squares once a week from now until July 25th, and confine these infested squares in wire cloth cages near the cotton field.

2. Read carefully the article upon "The Boll Weevil and the Boll Worm," which was furnished the press of the State a few days ago (if you cannot find this article in your home paper write to the State Crop Pest Commission at Baton Rouge for a copy), and apply the measures therein given for protecting the crop against this pest as well as against the weevil.

BATON ROUGE, LA., June 10, 1907.

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CIRCULAR No. 16

OF THE

State Crop Pest Commission

OF

LOUISIANA

THE MOST IMPORTANT FACTOR IN SOLVING THE BOLL WEEVIL PROBLEM

BY

AUGUST MAYER

ISSUED UNDER DIRECTION OF THE

STATE BOARD OF AGRICULTURE AND IMMIGRATION

CHAS. SCHULER, Commissioner

BATON ROUGE:
The Daily State, Official Journal of Louisiana.
1907.

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PREFACE.

Since the Civil War no factor has been as instrumental in altering agricultural conditions in the South as the advent of the boll weevil.

While it is of the greatest importance that every effort still be put forth to secure remedies and especially to secure control of the weevil by natural factors and to encourage natural enemies and parasites of the weevil by continued entomological work, it is not, at the same time, amiss to consider other factors—fully as important as these—which will enter into the final solution of the problem.

The South is favored with a natural monopoly on the world's greatest staple, and this monopoly the Southern farmer must maintain despite the weevil.

That this can be done is already being demonstrated by many a progressive farmer in Texas and Louisiana who, by diligent study and observation, has learned the scientific principles upon which agricultural work must be conducted to bring the highest returns, and who has learned how to apply these principles on his own farm by fertilizing intelligently, cultivating according to the needs of his crops and by diversifying in such a manner as to make each crop not only yield a profit, but also contribute, directly or indirectly, to the fertility of his lands and to the bounty of succeeding crops.

To continue producing cotton profitably despite the weevil will require soils kept in the best of physical condition and containing an ample supply of plant food. The fertility of Louisiana soils cannot be conserved indefinitely without live stock being produced in greater abundance than at present. To the profitable production of beef and dairy cattle, the Texas fever cattle tick stands as the greatest obstacle. With this arch enemy of both the cattle raiser and cotton grower exterminated, no finer stock raising country in the world can be found than in Louisiana. The future successful culture of cotton depends directly upon the eradication of the cattle tick.

The importance of the tick eradication movement, now obtaining such promising headway in the Southern States, is convincingly shown in the subjoined article by Mr. August Mayer, the well-known cattle raiser of Shreveport, La. Mr. Mayer has kindly accorded us permission to publish his article, and we believe every cotton planter, every manufacturer, every consumer of cotton goods and everyone interested even remotely in the success of Southern agriculture, can read Mr. Mayer's article with both interest and profit.

WILMON NEWELL, Secretary,
State Crop Pest Commission of Louisiana.

Baton Rouge, La., June 20, 1907.

State Crop Pest Commission
OF LOUISIANA.

CIRCULAR NO. 16. June 20, 1907.

The Circulars of the State Crop Pest Commission are sent free of charge to all farmers and fruit growers of Louisiana who make application therefor.

THE MOST IMPORTANT FACTOR IN SOLVING THE BOLL WEEVIL PROBLEM.

BY AUGUST MAYER.

The wisdom of Congress in making appropriations at its last two sessions for the eradication of the Texas fever cattle tick is quite apparent from the annual report of the Secretary of Agriculture, as it is also from personal observation to those living within the affected territory who have taken an active interest in this momentous movement against what is perhaps the greatest enemy to American agriculture. I dare say that the interest aroused among Southern agriculturists and stockmen particularly, and to a great extent the people generally, in this new work has surprised even the most sanguine of those responsible for the war against the tick. The short campaign of only a few months' duration conducted by the Department of Agriculture, with only very limited means at its command, has proven that the work authorized by Congress was well timed, and that the greatest good may be expected from continued and larger agitation and practical work under the direction of the Agricultural Department. It needs only the cordial support of Congress for several years and the National Department of Agriculture, with co-operation of the several infested states, and we will drive this costly pest from our continent.

Moreover, we are not certain but what even more comprehensive plans for eradication can be perfected, and these must be based upon an exhaustive study of the tick from the entomological standpoint to determine its vulnerable points under all conditions.

I have on former occasions, by speech and by writing, shown the enormous benefit to be derived from the eradication of the cattle tick. In those utterances I have chiefly dwelled on the subject from the standpoint of the husbandman. But there is a feature to it that has not been extensively mentioned as yet, and with which I, as a cotton grower, am much more concerned than as a producer of live stock. Indeed, for the Southern United States this view of the matter, to which I wish now to call your special attention, is much more important and far-reaching than all others.

The point which I wish to make clear and bring prominently to your attention is this: *That the eradication of the cattle tick is a necessity in order to maintain the future undisputed supremacy of the United States in the production of cotton.*

I will say that at the present and in the immediate future the cattle tick, as an indirect enemy to the cotton industry, exceeds in importance the muchly and justly dreaded boll weevil, and that, as an enemy to the cotton industry, the cattle tick constitutes from now on until it is eradicated from the cotton producing states, a more important factor in our national economy than it does directly as a hindrance in the production of live stock, notwithstanding the enormity of the damage caused by it in the latter role.

The chief industry of the Southern United States should and must forever be the production of cotton, for more than one reason.

First, among all known lands ours seems best suited to the growing of this one great world necessity.

Second, it is the product which makes foreign countries yearly our debtors in the interchange of goods.

Third, cotton, among all products of the earth brought forth directly by the soil, is the one most ideally adapted for a country's export, because by the exportation of the cotton fibre we do not rob our soil of any appreciable amount of fertility, which cannot be said of any other exported product of the soil. *The sending abroad of our surplus cotton is therefore all gain.* The energy of our agriculturists ought, therefore, to be persistently directed to the growing of cotton as their main crop. This should be the policy of our government. We should never permit our supremacy in this field to be put under a cloud for a moment. The fear occasioned recently by the advent of the boll weevil in our country, that the United States would in the near future, or sooner or later, be incapable of furnishing what cotton the foreign spinners need, has caused greater activity in foreign lands in growing the crop which is America's greatest export, and to which is due our country's healthy bank account in those foreign countries. This fear should be dispelled once and for all, to hold what we have for all times. How can we do this? I say: *"Eradicate the cattle tick."*

The boll weevil is here to stay, as far as we can see at present. By research and experiment it has been demonstrated that under certain conditions the boll weevil need not interfere with the successful growing of cotton. On the contrary, we have lately frequently seen greater yields of cotton in boll weevil infested territory than ever before. This was in many instances not accidental or due to natural causes, but to the artificial conditions created by man, in this instance by the farmer. What are these conditions? I will enumerate them in the order of their importance, as was shown by my own experiments, as well as those of others, to-wit:

First, the preparation and the mechanical condition of the soil, *before planting.*

Second, the proper fertility of the soil.

Third, proper, rapid cultivation after planting.

Fourth, the proper variety of seed.

As will be seen, the *preparation* of the soil—the seed bed—*before planting,* is the most important factor in the successful raising of cotton. The proper preparation of the soil, its physical condition, for the reception of the seed, and thereafter the growing of the cotton plant, is very largely dependent on the humus contained in the soil. If the soil has been deprived of this vegetable substance it is very nearly sterile and valueless as a producer of crops. Fields continually planted in one crop will eventually have no humus left in them (and thus become profitless to the farmer), *unless the necessary humus is regularly restored by fertilization and rotation of crops.* NO FERTILIZATION IS EQUAL TO THAT BROUGHT ABOUT BY THE USE OF STABLE MANURE OR THAT DUE TO THE FEED LOT. It will restore the soil better than any other fertilizer, especially if rotation of crops is practiced also. To secure, therefore, the greatest requisite to successful cotton planting, *i. e.,* perfect preparation of soil and favorable soil conditions, *we should have fertilization with stable manure.* To have stable manure we must have live stock, especially cattle, to utilize to the fullest our cotton seed and the roughage produced by a soil-conserving agriculture. To have cattle we must be rid of the parasitic fever tick. And conversely, if we are rid of this tick we will have cattle, and thence stable manure, and also rotation of crops, as a live stock industry has this in its wake. And consequently we will have the foremost requisites for the successful cultivation of cotton; that is to say, a friable, rich soil, warm early in spring, moisture-retaining during drouth, stimulating to plant growth throughout the growing season; in other words, all the foremost essentials to the growing of a profitable cotton crop in a boll weevil affected country. I assert, that with the thorough preparation of such a soil, as soon as the seed is entrusted to it half of the crop is made, and seventy-five per cent of the ordinary risk of crop production is overcome.

The second essential in the successful culture of cotton (in a weevil infested territory) is the proper fertility of the soil. It is quite a mooted question as yet in how far chemical fertilizers do contribute to soil improvement, especially if used alone for a long period of time. Aside from the objectionable feature of great cost, chemical fertilizers must also be objected to in that they do not restore humus, *i. e.,* "life," to the soil. To properly fertilize the soil so as to bring about this second most necessary feature of the successful production of cotton in the weevil infested country we must have a healthy live stock industry, consisting mainly of cattle.

With soil preparation, and fertilization with stable manure to have a seed bed as nearly perfect as possible, and practicing crop rotation, the yield of cotton per acre can be very greatly increased with the boll weevil present. It can be doubled over the yields of former years by all, trebled by many, and even quadrupled by the few most expert and intelligent. My own experiments have led inevitably to these conclusions. In other words, I wish to state in the most emphatic terms that, comprehensively viewed, *the eradication of the Texas fever cattle tick will more than offset the invasion of the boll weevil*, concerning the production of cotton.

Rid our country of the tick, and a live stock industry will follow in the cotton growing states as a subsidiary industry. We will rotate our crops, and we will grow cotton right. We will grow cotton in quantities to suit the demand of the world. No one need thereafter ever fear that the United States will not be able to furnish what cotton the world needs. We are good for thirty million bales on half the land now in cotton culture, provided we are rid of the cattle tick.

America's greatest export need not be put in jeopardy ever if we exterminate the cattle tick. The extermination of the Texas fever tick will be notice to all the world that we will have no competitors in the cotton producing industry. Our bank account in foreign countries will swell to greater proportions from year to year, due to the ever increasing exportation of cotton; this, of course, provided the cattle tick is driven from our country.

Rid our fair land of this pest, then the South will be a cotton country greater than ever; a country of plenty such as the world has never seen.

Cotton should and will forever remain our chief crop. It is the ideal crop for the South. It is the ideal crop for a country's export. Its continued exportation will only make our country richer with every year; for, if we should send twenty million bales of cotton—pure cellulose—abroad each season, equivalent to ten thousand million pounds—or even on a still greater scale—we would not send along with it enough of our soil fertility to decrease our yield any for a thousand years to come. But our ships would return with the foreigners' gold to the tune of one billion dollars per year—all this and much more, only—provided, we exterminate the cattle tick.

To maintain our cotton industry in its supremacy is but the soundest statesmanship. To keep the cotton crop at its supremacy in the Southern United States is statesmanship equally renowned. To maintain and ever increase our cotton exports should be our government's never-failing policy. Such aim will make us permanently the creditor nation of the world. To export cotton—cellulose—is truly a country's ideal business with foreign people, for there is connected with it no loss—all is gain.

Eradicate the cattle tick!

824-

CIRCULAR No. 17

OF THE

State Crop Pest Commission

OF

LOUISIANA

THE STATE CROP PEST LAW OF LOUISIANA

—AND—

Rules and Regulations of the State Crop Pest Commission, In Effect July 1, 1907.

ISSUED UNDER THE DIRECTION OF THE

STATE BOARD OF AGRICULTURE AND IMMIGRATION

CHAS. SCHULER, Commissioner

BATON ROUGE:
THE DAILY STATE, OFFICIAL JOURNAL OF LOUISIANA.
1907.

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STATE CROP PEST COMMISSION OF LOUISIANA.

ORGANIZATION.

Hon. NEWTON C. BLANCHARD, Governor of Louisiana.

Hon. CHAS. SCHULER, Commissioner of Agriculture.

Professor W. R. DODSON, Director, State Experiment Stations.

WILMON NEWELL, Entomologist, State Experiment Stations.

Hon. L. S. FRIERSON.

Hon. B. W. MARSTON.

STAFF.

WILMON NEWELL, Entomologist and Secretary.

Miss L. E. RENNEKER, Clerk and Accountant.

ARTHUR H. ROSENFELD, Assistant Entomologist, Fruit Insect Control and Miscellaneous Investigations.

C. W. FLYNN, Jr., R. G. TILLERY, Assistant Entomologists, Cattle Tick Eradication.

M. S. DOUGHERTY, T. C. BARBER, Assistant Entomologists, Cattle Tick Investigations and Experiments.

G. A. RUNNER, Assistant Entomologist, Nursery and Orchard Inspection.

T. C. PAULSEN, C. E. HOOD, Assistant Entomologists, Boll Weevil Investigations.

J. B. GARRETT, Assistant Entomologist; located at North Louisiana Experiment Station, Calhoun, La.

Dr. C. E. MAULDIN, Dr. WALTER SORRELL, Dr. T. BYRON CRACROFT, P. P. KNOWLES, J. M. BECKHAM, J. E BAKER, C. M. DAVIDSON, C. L. ANDREWS, Inspectors, Cattle Tick Eradication.

tate Crop Pest Commission
OF LOUISIANA.

IRCULAR. No. 17. July 1, 1907.

The Circulars of the State Crop Pest Commission are sent free of charge to armers and fruit growers of Louisiana who make application therefor.

THE STATE CROP PEST LAW OF LOUISIANA

AND

LES AND REGULATIONS OF THE STATE CROP PEST COMMISSION, IN EFFECT JULY 1, 1907.

INTRODUCTORY.

To meet a growing demand for information concerning the 's and regulations of the State which have to do with pre- ting the dissemination of injurious insects and plant diseases, l to furnish nurserymen, oil mill managers, railroad officials l express agents with a manual for ready reference, it has n deemed advisable to publish in pamphlet form all of the ulations of the Crop Pest Commission now in force.

Fruit growers and farmers, as well as all business interests endent directly or indirectly upon the agricultural resources the State, are realizing more and more the necessity of pre- ting the unrestricted distribution of pests which, in seasons orable to their rapid increase, often destroy the greater por- n, or occasionally all, of some important crop.

The need for such protection for the staple crops and fruits the State has made itself felt in the increased demands made n the State Crop Pest Commission, with the result that the mmission's regulations now deal not only with the boll weevil, with the San Jose scale and the Texas fever cattle tick, as l as with ten dangerous insect and fungous enemies of fruits.

Fruit growers particularly should be posted upon the relations of the Commission, in order that they may avail th selves of the protection offered by the Commission, and in or that they may the better guard against unscrupulous fruit t agents who may attempt to impose upon them with disea nursery stock.

Although the Regulations of the Commission become, ef tive upon their publication in the official journal of the State, advantage and convenience of having them brought together convenient form for ready reference will be self evident to many farmers, shippers and others who have occasion to cons them from time to time.

In the present publication, Act. No. 6 of the Extra Sessi of 1903 (which created the State Crop Pest Commission and ga it authority to deal with pests inimical to the horticultural a agricultural interests of the State) is first given. Following th Act will be found the regulations of the Commission, arranged the following order:

Insects and Fungous Diseases Declared by the Commissi to be Dangerously Injurious.

General Regulations for the Government of the Entomol gist, Assistants, Inspectors and Other Employees of t Commission.

Regulations Governing the Sale and Shipment of Nurser Stock.

Regulations for Facilitating the Work of Cattle Tick Erad cation.

Boll Weevil Quarantine Regulations.

The regulations of the Commission are subject to amen ment from time to time as the Commission may deem necessa or expedient, and the regulations herein given are those in eff at the present date.

WILMON NEWELL,
Secretary.

BATON ROUGE, July 1, 1907.

THE STATE CROP PEST LAW OF LOUISIANA.

AN ACT.

(Act No. 6. House Bill No. 6—By Mr. Sellers.)

provide for the establishment and organization of a State Crop Pest Commission and to define the duties and powers of the same; to fix penalties for the violation of any of the rules, orders, ordinances and regulations thereof; to make it a misdemeanor for any person, firm or corporation to bring into this State or have in possession, except certain persons, any living Mexican Boll Weevil in any of its stages, and providing a penalty therefor; to provide for the publication and distribution of all the proceedings and recommendations of said Commission; to authorize said Commission to restrain by injunction or otherwise any violations, or threatened violations, of its orders, rules, ordinances and regulations, and to prohibit any court of the State from bonding the same prior to trial on the merits; to make it the duty of the Attorney General and District Attorneys to represent said Commission and the Sheriff to serve all papers for said Commission; to provide for the payment of all fines and forfeitures for violations of the orders, rules, ordinances and regulations of said Commission to the State Treasurer, and by him to be placed to the credit of said Commission; to relieve said Commission of the necessity of giving bond or security in any legal proceedings which it shall institute or defend in any court of justice in this State; to make an appropriation to carry out the provisions of this Act and to repeal all laws or parts of laws inconsistent or in conflict with the same.

State Crop Pest Commission created.
Members.
Domicile.
Meetings.
Per Diem.
Secretary.

Section 1. Be it enacted by the General Assembly of
State of Louisiana, That a State Crop Pest Commission for
State of Louisiana is hereby created and established, to co
of the Governor as ex-officio chairman, the Commissioner
Agriculture, the Director of the State Experiment Station,
Station Entomologist and two experienced resident cotton pl
ers, the latter to be appointed by the Governor, and every
years thereafter, and who shall serve for four years and u
their successors are duly appointed and qualified. The Sta
Entomologist and the two planters shall be commissioned
shall qualify in the same manner as provided by the Constitu
and laws of the State for all other officers. Said Commis
shall have its domicile at Baton Rouge and shall hold its
session at said place immediately after the promulgation of
Act, and at such other times and places as may be designated
said Commission. At any meeting of said Commission any th
members shall constitute a quorum to transact business.
members of said Commission, not salaried under the State
ernment, shall receive the sum of five ($5) dollars per day
each day consumed in going to and returning from any of
meetings of said Commission, and while in attendance ther
and necessary traveling expenses, which amount shall be paid
the State Treasurer on the voucher of the member, approved
the Governor, out of any funds to the credit of said Commis
Said Commission shall elect one of its members secretary,
shall appoint such other assistants as may be necessary to c
on the work of said Commission, and shall fix their compensat

Chairman; his duties.

Sec. 2. Be it further enacted, etc., That for the purpos
carrying out the rules, ordinances, orders and regulations of
Commission, as hereinafter provided, the Commissioner of A
culture shall be the active chairman of said Commission, an
such shall see that all the rules, ordinances, orders and reg
tions of the same are faithfully executed; and in addition to
duties, the active chairman shall have the power, during the
terval between the meetings of said Commission, and when
same is not in session, to issue all orders, and to take all neces
steps, by suit or otherwise, to execute the laws of the State on
subject matter delegated to said Commission, and to carry

rules, ordinances, orders and regulations of said Commission le thereunder; and he may, in his discretion, call special meet- of the Commission whenever, in his opinion, an emergency l require it, provided, that in all cases where two or more ıbers shall demand the same, it shall be his duty to convene same in special session.

Sec. 3. Be it further enacted, etc., That said Commission l have full and plenary power to deal with all crop and fruit s and such contagious and infectious crop and fruit diseases in the opinion of the Commission, may be prevented, con- led or eradicated; and with full power and authority to make, mulgate and enforce such rules, ordinances, orders and regu- ons, and to do and perform such acts as, in their judgment, y be necessary to control, eradicate and prevent the intro- tion, spread or dissemination of the Mexican Boll Weevil in State, and all other injurious crop and fruit pests and dis- s as far as may be possible, and all the rules, ordinances, ers and regulations of said Commission shall have the force l effect of law so far as they conform to the general laws of State and the United States. Said Commission, in the exer- of the power and authority hereby delegated, shall have hority to prohibit the shipment or bringing into this State of y cotton seed or other article of farm product, or any other icle of any nature or character whatsoever from any State, ritory or foreign country, or consigned from points within y State, Territory or foreign country, where the boll weevil or y other infectious or contagious crop or fruit disease exists, ex- t under such rules and regulations as may be adopted by said mmission.

Power to make and enforce rules to prevent the spread of insects and diseases dangerous to the agricultural interests of the State.

Sec. 4. Be it further enacted, etc., That any firm, person or poration, except a duly recognized State or Federal entomolo- t, who shall bring into this State, or have in possession, for y purpose, any living Mexican Boll Weevil, cotton boll, square, nt or seed containing the Mexican Boll Weevil, whether adult in the pupal, larval or egg state, shall be deemed guilty of a sdemeanor, and shall, upon conviction, be fined not less than enty-five nor more than one thousand dollars for each offense, be imprisoned for not less than ten days nor more than six

Making it a misdemeanor to have in possession any living boll weevil, or infested cotton plant or cotton square, boll, etc.

months. Prosecutions under the provisions of this section m be instituted and carried on in any parish where any pers firm or corporation may be found with, or shown to have had possession, any living Mexican Boll Weevil, cotton boll, squa plant or seed containing the Mexican Boll Weevil, whether ad or in the pupal, larval or egg state.

Penalty for violating rules made by the Commission.

Prosecutions, how conducted.

Duty of Attorney General and District Attorneys.

Sec. 5. Be it further enacted, etc., That any person, fi or corporation violating any of the rules, ordinances, orders regulations of said Commission, shall be guilty of a misdemean and shall, upon conviction thereof, be punishable by a fine of less than twenty-five nor more than one thousand dollars, imprisonment for not more than six months nor less than thi days. All prosecutions under this Act shall be commenced a carried on in any parish of the State affected by the violation said orders, ordinances, rules and regulations, and the said Co mission may enjoin any threatened or attempted violations its rules, orders, ordinances and regulations in any court of co petent jurisdiction, or take any other civil proceedings necessa to carry out and enforce the purposes of this Act; and no co of this State shall have the right previous to final trial to aside said injunction on bond. It shall be the duty of the A torney General and the various District Attorneys to rep sent said Commission whenever called on to do so; and s Commission in the discharge and enforcement of the dut and powers herein delegated, may send for books and pap swear witnesses, etc.; and it is hereby made the duty of t various Sheriffs throughout the State to serve all papers, su mons, etc., that may be delivered to them by said Commission

Rules, regulations and bulletins to be published and distributed under direction of Louisiana State Board of Agriculture and Immigration.

Sec. 6. Be it further enacted, etc., That said Commission their first session shall prepare and publish a list of dangero crop and fruit pests, and infectious and contagious plant d eases, known or suspected to be present within the State or lia to be introduced, and may at any subsequent meeeting extend amend said list. The Commission shall also publish methods f exterminating such pests or infectious diseases as they may de capable of being exterminated within the boundaries of t State, and for suppressing such as cannot be exterminated, a for preventing the spread of such pests or diseases within t

ate; and for the purpose of disseminating knowledge concern-
contagious diseases or injurious pest affecting crops, plants,
es, etc., and the remedies, preventatives and disinfectants
plicable thereto, the Commission shall from time to time, as
y may deem necessary, have printed and distributed bulletins
taining such information, remedies, preventatives and dis-
ectants as they may approve, including also the rules, orders,
linances and regulations of said Commission, which said bul-
ins shall be printed and distributed to all interested persons
ler the direction and supervision of the Louisiana State
ard of Agriculture and Immigration. When the said Com-
sion has reason to suspect that any pest or plant disease listed
them as dangerous, exists in any parish of the State, they
ll cause such suspicion to be verified by a person competent
determine the specific identity of such crop pests or disease
plant, and if such suspicion prove well founded, the inspector
said Commission shall immediately take charge of said in-
ted property and adopt such measures for the treatment or
ermination of same as the Commission may direct. Any duly
horized agent of the Commission shall have authority to in-
ct any building, warehouse, depot, or place where any prop-
is located, or premises or field supposed to be infested by
crop pest or disease, listed and published as such by the
Commission, and if, in the opinion of the Entomologist
cted by said Commission, it shall be necessary to destroy
property so infested so as to prevent the further spread
said injurious crop pest or disease, he shall have authority
destroy said property, and the Commission shall have the
it to fix a compensation to be awarded the owner thereof.
the owner should be dissatisfied with the amount allowed
said Commission as compensation for the property destroyed,
shall have the right to appeal to the court of the parish
which such property is destroyed, but in no case shall any
test as to the value of the property to be destroyed suspend
on by the Commission in enforcing their rules, orders, ordi-
ces and regulations. Any one who shall seek to prevent any
ection under the direction of said Commission, or who shall
rwise interfere with the agents or employees of said Com-
sion while in the performance of their duties, shall, upon

Authority to make inspection and to destroy infested or infected property.

Compensation for property destroyed.

Right of appeal by owner of destroyed property.

Penalty for interfering with agents of Commission in discharge of their duty.

conviction, be fined not less than twenty-five dollars nor than five hundred dollars for each offense, or may be impris for not less than ten nor more than thirty days. Prosecu under the provisions of this section shall be instituted in parish of the State in which the offense is committed.

Collected fines to be paid into the State Treasury.

Sec. 7. Be it further enacted, etc., That all fines coll from prosecutions under the provision of this Act shall be to the State Treasurer and by him placed to the credit of Commission.

Commission exempted from giving bond.

Sec. 8. Be it further enacted, etc., That said Commis shall not be required to give any bond or security in any proceedings which it shall institute or defend in any cour justice in this State.

Appropriation.

Sec. 9. Be it further enacted, etc., That for the purpos carrying out the provisions of this Act the sum of $25,000, much thereof as may be necessary, is hereby appropriated ou any funds in the Treasury not otherwise appropriated, and be paid by the State Treasurer upon properly authentic vouchers signed by the president or secretary of said Com sion.

Sec. 10. Be it further enacted, etc., That all laws or of laws in conflict or inconsistent with this Act, be and the are hereby repealed.

J. Y. SANDERS,
Speaker of the House of Representativ
H. C. CAGE,
President pro tem. of the Senat

Approved December 15, A. D. 1903.

W. W. HEARD,
Governor of the State of Louisian

A true copy:
JOHN T. MICHEL,
Secretary of State.

REGULATIONS OF THE STATE CROP PEST COMMISSION,

IN EFFECT ON JULY 1, 1907.

opted and Promulgated by the Commission in Accordance with the Foregoing Act of the State Legislature.

SECT PESTS AND FUNGOUS DISEASES DECLARED BY THE COMMISSION TO BE DANGEROUSLY INJURIOUS.

SECTION I.*

Be it declared, ordained and ordered, that the following in-ts and diseases are hereby declared to be dangerous crop and uit pests:

Insects and diseases declared dangerously injurious.

(*a*) The boll weevil (*Anthonomus grandis*).
(*b*) The Texas fever cattle tick (*Boophilus annulatus*).
(*c*) The San Jose scale (*Aspidiotus perniciosus*).
(*d*) Nematode root knot (*Heterodera radicicola*).
(*e*) The cottony cushion scale (*Icerya purchasi*).
(*f*) The West Indian peach scale (*Aulacaspis pentagona*).
(*g*) The woolly aphis (*Schizoneura lanigera*).
(*h*) The white fly (*Aleyrodes citri*).
(*i*) The chaff scale (*Paralatoria pergandei*).
(*j*) The Morelos orange fruit worm (*Trypeta ludens*).
(*k*) Crown gall; hairy root disease.
(*l*) Black knot.

Provided, however, that this Commission may, from time time, declare other fruit and crop pests or diseases to be ngerous.

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*As amended by the Commission at its meeting April 11, 1907.

General Regulations Relative to Entomologist, Assista Inspectors, Etc.

SECTION II.†

Entomologist: duties of.

Be it further declared, ordained and ordered that the
periment Station Entomologist shall be the Entomologist of
Commission; and it is hereby made his duty, with the assista
of the inspectors hereafter provided for, to carry out and
force the provisions of Act No. 6 of the Extra Session of
Legislature of the State of Louisiana, approved December
1903. In the enforcement of the said Act of the Legislature
shall have the right, and it is hereby made his duty, whene
the public exigencies require it, to prevent the bringing into
carrying through the State of Louisiana of any of the propert
articles or things hereby quarantined against, and to condem
and cause the same to be destroyed, as well as to condemn an
cause to be destroyed all other property, premises or fields i
this State infested with any seriously injurious insect or di
ease.

SECTION III.†

District Attorneys: their duties to assist Commission.

The District Attorneys throughout the State are hereb
especially enjoined to aid and assist this Commission in carryin
out the provisions of Act No. 6 of the Extra Session of th
Legislature of this State, approved December 15, 1903, as
made their duty by Section 5 of said Act.

SECTION IV.†

Assistant Entomologists: their duties, etc.

Be it further declared, ordained and ordered that, in add
tion to the Entomologist of this Commission, the Executi
Committee of this Commission may, and is hereby given pow
and authority to appoint necessary assistant entomologists, wl
shall perform such duties as may be assigned to them by the E
tomologist of this Commission, and who shall be under h
supervision and control and shall be subject to removal or di
missal by the Executive Committee of this Commission whe
ever, in its opinion, it may deem advisable to dispense with the
services; such assistant entomologists shall receive and be pa
such a salary as may be fixed by the Executice Committee, pa

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†As amended and adopted by the Commission at its meeting, November 1905.

able by the State Treasurer on the voucher of the Secretary of this Commission, approved by the Governor, out of any funds to the credit of the Commission.

SECTION V.†

Inspectors: appointment of, their duties, etc.

Be it further declared, ordained and ordered that as many inspectors as may be necessary be appointed by the Executive Committee of this Commission; such inspectors shall perform their duties under the direct supervision and control of the Entomologist of this Commission. Each inspector shall receive such a salary for his services as the Executive Committee may fix, payable monthly by the State Treasurer out of any funds to the credit of said Commission, on the voucher of the Secretary of the Commission, approved by the Governor. Inspectors shall be liable to removal or dismissal by the Entomologist of this Commission whenever, in his opinion, it may be advisable to dismiss or remove them. It is hereby made their duty to prevent the bringing into or through the State of Louisiana of any of the articles, property or things hereby quarantined against, and to prevent the shipment or removal from any infested place in this State, to any place in this State not infested, of any of the articles, property or things which it is hereby declared shall not be removed; and, acting under the authority and control of the Entomologist of this Commission, and whenever deemed necessary by him, to destroy any and all such property, as well as any and all growing crops, fields, premises and other property which may be infested with any seriously injurious insect or disease. It is hereby further made their duty to cause the arrest of any and all persons guilty of violating any of the rules, orders or regulations of this Commission, as well as any of the provisions of Act No. 6 of the Extra Session of the Legislature of the State of Louisiana, approved December 15, 1903.

SECTION VI.†

Payment for confiscated property.

Be it further declared, ordained and ordered that compensation, when paid for property destroyed, shall be fixed by this Commission in the manner provided by Section 6 of Act No. 6 of the Acts of the Legislature of this State, approved December 15, 1903.

REGULATIONS GOVERNING THE SALE AND SHIPMENT OF F TREES AND OTHER NURSERY STOCK.

SECTION VII.*

Sale, shipment or delivery of infested trees or plants prohibited.

No firm, person or corporation shall sell, ship, excha deliver or give away, within the State of Louisiana, any t vines, shrubs, buds, cuttings or plants, or parts of plants, fested with the San Jose scale, nematode root knot, cott cushion scale, chaff scale, West Indian peach scale or white or infected with crown gall, hairy root disease or black knot.

SECTION VIII.†

Shipments of nursery stock from other States: must bear inspection certificate.

(*a*) All nursery stock shipped into this State from a other State or country shall be prominently labeled wtih a c tificate of inspection signed by the State Entomologist, or ot duly authorized official, of the State or country in which s stock was grown. All common carriers and their agents a hereby forbidden to deliver at any point in this State any sh ment of nursery stock not labeled with a valid and unexpi certificate of inspection, signed either by the Secretary of t Crop Pest Commission of Louisiana or by the State Entom ogist or other duly authorized official of the State or count where such stock was grown. Shipments not so labeled sh be liable to confiscation upon the order of the Entomologist the Crop Pest Commission.

Transportation companies: must notify Secretary on arrival of uncertified shipments of nursery stock.

(*b*) Transportation companies and their agents shall i mediately notify the Secretary of the Crop Pest Commiss (Baton Rouge, Louisiana), when by oversight, negligence otherwise, any shipment of nursery stock, without a proper c tificate attached, shall arrive at any station or wharf in t State, and it shall be the duty of the Secretary to proceed speedily as possible, by himself or his assistant, to investig and dispose of such shipment.

Entomologists and assistants: have authority to inspect shipments; also to confiscate infested shipments.

(*c*) The Entomologist and his assistants shall have auth ity to inspect any shipment of nursery stock at any station wharf in this State, and shall have authority to stop any n sery stock when in transit, for the purpose of inspecting t same, regardless of whether such stock shall bear a certific of inspection or not. The Entomologist shall have authority to seize, condemn and destroy any nursery stock infested with San Jose scale or other seriously injurious insect or disease, found within the confines of this State.

SECTION IX.†

Nurserymen: must apply for inspection before July 1st of each year; must attach certificates to shipments and deliveries.

Each and every person, firm or corporation growing nursery stock for sale in this State shall apply to the Secretary of the Crop Pest Commission for inspection on or before July 1 of each year. It shall be the duty of the Secretary to inspect such nursery not later than November 1. If upon such inspection the nursery stock and premises be found apparently free from the San Jose scale and other seriously injurious insects and plant diseases, a certificate shall be given to that effect. On and after August 1, 1905, a copy of said certificate, bearing the seal of the State Crop Pest Commission and the *fac-simile* signature of the Secretary, shall be attached to each and every box, bundle and package of nursery stock shipped within the State. Shipments of nursery stock not so labeled shall be refused for shipment by all common carriers and their agents, and such stock, if found in transit or in the possession of any common carrier by the Entomologist or his assistants, shall be liable to confiscation.

Transportation companies: must refuse to accept uncertificated shipments of nursery stock.

SECTION X.†

Sale, shipment, delivery or gift of uncertificated nursery stock prohibited.

No firm, person or corporation shall sell, give away, exchange or deliver, within this State, any trees, vines, shrubs, or plants, commonly known as nursery stock, without same having attached thereto in a prominent manner, a copy of the certificate of inspection signed by the Secretary of the State Crop Pest Commission, or by the State Entomologist, or other duly authorized official of the State or country in which said nursery stock was grown.

SECTION XI.‡

Citrus stock: must be defoliated before shipped or sold.

All orange, lemon, lime, sweet lime, kumquat, tangerine and grape fruit trees or plants sold or shipped within this State, or delivered within this State when shipped from another State or country, shall be completely defoliated. Shipments of such trees or plants not so defoliated intended for delivery within this State, when found in possession of any common carrier, corporation, firm, person or agent, or when found exposed or offere for sale within this State, shall be subject to confiscation by th Entomologist or his assistants or inspectors.

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‡Adopted by the Executive Committee August 29, 1906; ratified by the entire Commission at its meeting April 11, 1907.

SECTION XII.†

Fumigation of trees, etc.: when required.

The Entomologist of the Commission shall have power t require any one in the State to fumigate his trees, shrubs o plants with hydrocyanic acid gas or other substance when, i his judgment, such treatment is necessary or advisable for th proper protection of the agricultural or horticultural interests of the State, or of any section thereof.

SECTION XIII.‡

Orange fruit worm: sale of infested fruit prohibited.

The sale, or offering for sale, within this State, of any oranges, sweet limes or other fruits infested with the Morelos orange fruit worm, is hereby forbidden. Any fruit, infested with this pest, found exposed for sale or in the possession of any firm, corporation, common carrier, dealer, agent or person within the confines of this State, by any inspector of the State Crop Pest Commission, shall be immediately seized by him and destroyed by burning. Violations of this section shall be punished as provided by Section 5 of Act No. 6 of the Extra Session of 1903.

Violations: how punished.

REGULATIONS FOR FACILITATING ERADICATION OF THE TEXAS FEVER CATTLE TICK IN LINCOLN AND CLAIBORNE PARISHES.

Whereas, representatives of the State Crop Pest Commission of Louisiana have canvassed the cattle tick situation in Lincoln and Claiborne Parishes of this State, and report that the conditions in said parishes are such as to make it feasible to eradicate the cattle tick from them, through the co-operative work of this Commission and the representatives of the Bureau of Animal Industry of the United States Department of Agriculture, and that the intelligent sentiment of these parishes is in favor of undertaking the work of eradicating the cattle tick and

Whereas, at its meeting held at Baton Rouge, La., April 11, 1907, the State Crop Pest Commission authorized the under-

SECTION XXII.§

As soon as the cattle tick has been eradicated from the public roads of all or any portion of Lincoln and Claiborne parishes, and this fact is announced by a representative of this Commission, the inspectors of the Commission shall issue permits for the movement of cattle not infested with the cattle tick on these roads from one portion of non-infested territory to another portion of the non-infested territory, provided such cattle shall not be allowed at any time to come into territory infested with the cattle tick or come in contact with cattle infested with the cattle tick. In case cattle are being removed under permit and become infested with the cattle tick, in violation of the purpose of these regulations, said cattle shall be put in quarantine by the inspector of this Commission, and shall be moved only under his permit and direction. Any party or parties, company or corporation driving or transporting, or allowing to be driven or transported, any cattle, carcasses or green hides, except as provided for by these regulations, shall be declared guilty of violating the regulations of this Commission, and shall be punished accordingly, as provided for in the law establishing this Commission.

Tick-free cattle: may be moved on public roads under permit of inspector.

REGULATIONS PERTAINING TO THE BOLL WEEVIL.¶

SECTION XXIII.†

Be it further declared, ordained and ordered that no person, firm or corporation, except a duly authorized State or Federal entomologist, shall bring into or have in his possession, in the uninfested portion of the State of Louisiana, for any purpose whatever, any living boll weevil or cotton boll, square, plant or seed containing the boll weevil, whether adult or in the pupal, larval or egg state; and any such person, firm or corporation violating this provision of the Act of the Legislature shall, on conviction, as prescribed by Section 4 of Act No. 6 of the Extra Session of the Legislature, approved December 15, 1903, be fined not less than twenty-five dollars, nor more than one thousand dollars for each offense, or imprisoned for not less than ten days, nor more than six months.

Having live boll weevils in possession in uninfested portion of State; prohibited.

Penalty for; fine or imprisonment.

¶The boll weevil quarantine is amended from time to time, as the territory infested by the boll weevil increases.

SECTION XVIII.§

Violation of Regulations; penalty.

Any person or persons, company or corporation bringing, or allowing to be brought, cattle into Lincoln or Claiborne parishes, except as provided for in these regulations, shall be declared as guilty of violating the orders of this Commission, and shall be punished as provided for by law.

SECTION XIX.§

Cattle, carcasses, green hides infested by cattle-tick; not allowed on public roads of Lincoln or Claiborne Parish.

Cattle, undressed carcasses and green hides thereof, infested with the Texas fever cattle tick, shall not be allowed on the public roads or moved or allowed to be moved on boat, rail or conveyance from the premises of one party to the premises of another party until they are properly disinfected or declared free of cattle ticks by a representative of this Commission. Green hides twenty days old shall be considered free of ticks.

SECTION XX.§

Cattle, carcasses, etc.; shall not be moved from infested places to non-infested places, or to areas where eradication work is proceeding.

No cattle, carcasses or green hides infested with the Texas fever cattle tick shall be moved or allowed to be moved or go from any field or lot infested with the Texas fever cattle tick to a field or lot where the tick has been eradicated or where eradication is being undertaken under the advice and supervision of the representatives of this Commission.

SECTION XXI.§

Inspectors; required to assist owners of cattle in eradicating ticks.

As a means of protecting and assisting the live stock owners and farmers of Lincoln and Clairborne parishes it shall be the duty and privilege of duly authorized appointees of this Commission to visit all premises in the above named parishes and determine and specify all premises that are found free of the Texas fever cattle tick and such as are infested with said tick; and as a further protection and assistance to the live stock owners and farmers of the above named parishes it shall be the duty and privilege of appointees of this Commission to devise and direct such means as may be best suited to local conditions for disinfecting cattle and premises found infested with Texas fever cattle tcks.

SECTION XXII.§

As soon as the cattle tick has been eradicated from the public roads of all or any portion of Lincoln and Claiborne parishes, and this fact is announced by a representative of this Commission, the inspectors of the Commission shall issue permits for the movement of cattle not infested with the cattle tick on these roads from one portion of non-infested territory to another portion of the non-infested territory, provided such cattle shall not be allowed at any time to come into territory infested with the cattle tick or come in contact with cattle infested with the cattle tick. In case cattle are being removed under permit and become infested with the cattle tick, in violation of the purpose of these regulations, said cattle shall be put in quarantine by the inspector of this Commission, and shall be moved only under his permit and direction. Any party or parties, company or corporation driving or transporting, or allowing to be driven or transported, any cattle, carcasses or green hides, except as provided for by these regulations, shall be declared guilty of violating the regulations of this Commission, and shall be punished accordingly, as provided for in the law establishing this Commission.

Tick-free cattle: may be moved on public roads under permit of inspector.

REGULATIONS PERTAINING TO THE BOLL WEEVIL.¶

SECTION XXIII.†

Be it further declared, ordained and ordered that no person, firm or corporation, except a duly authorized State or Federal entomologist, shall bring into or have in his possession, in the uninfested portion of the State of Louisiana, for any purpose whatever, any living boll weevil or cotton boll, square, plant or seed containing the boll weevil, whether adult or in the pupal, larval or egg state; and any such person, firm or corporation violating this provision of the Act of the Legislature shall, on conviction, as prescribed by Section 4 of Act No. 6 of the Extra Session of the Legislature, approved December 15, 1903, be fined not less than twenty-five dollars, nor more than one thousand dollars for each offense, or imprisoned for not less than ten days, nor more than six months.

Having live boll weevils in possession in uninfested portion of State; prohibited.

Penalty for; fine or imprisonment.

¶The boll weevil quarantine is amended from time to time, as the territory infested by the boll weevil increases.

SECTION XXIV.||

(*a*) The following territory within the State of Louisian is declared to be at present non-infested by the boll weevil:

Uninfested territory; defined.

All that portion of the State east of the Mississippi River.*

Ascension Parish.
Concordia Parish.
East Carroll Parish.
Franklin Parish.
Iberia Parish.
Iberville Parish.
Lafayette Parish.
Madison Parish.
Morehouse Parish.
Pointe Coupee Parish.
Richland Parish.
St. Martin Parish.
Tensas Parish.
Vermilion Parish.
West Baton Rouge Parish.
West Carroll Parish.

All that portion of Catahoula Parish along Black River, commencing at Jonesville and running to the mouth of Black River, and extending back five miles from said river; also all that part of Catahoula Parish east of the Ouachita River.

The west bank of the Atchafalaya River, from the mouth of Yellow Bayou to Elba, for a mile back from the river (provided, however, that no cotton seed from said region shall be shipped to or transported into the Parishes of Pointe Coupee and West Baton Rouge except after inspection by an officer or officers named for the purpose by the Police Juries of said parishes and upon his or their permit).

||Regulations adopted by the Commission September 15, 1906, and including amendments made Sept. 25, 1906, Oct. 8, 1906, and Jan. 31, 1907.

*However, the port of New Orleans is exempted from the provisions of the quarantine established by this Section.

(b) No seed cotton, cotton seed nor cotton seed hulls shall be brought from territory or parishes infested with the boll weevil into the territory or parishes declared non-infested (provided, however, that cotton seed and hulls ginned at Arnaudville and Sunset in St. Landry Parish may be shipped or moved into St. Martin and Lafayette Parishes).

Transportation of seed cotton, cotton seed and hulls from infested to non-infested territory; prohibited.

(c) The Police Juries of the parishes declared non-infested are appointed agents of the Crop Pest Commission to enforce the quarantine established by this section, the expense of said quarantine in each parish to be borne by such parish.

Police Juries appointed agents of Commission to enforce quarantine. Parishes to bear expense of quarantine.

(*d*) The quarantine herein established against the infested parishes of Louisiana shall apply also to the States of Texas, Arkansas and Oklahoma.

Quarantine also operative against Texas Arkansas and Oklahoma.

PUBLICATIONS AVAILABLE.

The following publications of the Crop Pest Commission are still available for distribution and any of them desired can be obtained upon application to the Secretary of the Commission at Baton Rouge, Louisiana:

Circular No. 3.—The Cultural Remedy for the Boll Weevil (24 pages).

Circular No. 4.—The San Jose Scale: Its Nature and Habits; How to Detect It and How to Control It (42 pages).

Circular No. 6.—A Preliminary Report on the Horseflies of Louisiana, with a Discussion of Remedies and Natural Enemies (44 pages).

Circular No. 8.—Report of the Executive Committee upon the Paris Green Experiments Conducted Against the Boll Weevil During 1905 (32 pages).

Circular No. 9.—The Boll Weevil: Information Concerning Its Life History and Habits (30 pages).

Circular No. 10.—The Cattle Tick: Studies of the Egg and Seed Tick Stages: A Simple Method of Eradicating the Tick (32 pages).

Circular No. 11.—The Boll Weevil: Report on the Cultural Experiments in Co-operation with the Bureau of Entomology During 1906 (19 pages).

Circular No. 12.—Report on the Nursery Inspection Work of the State Crop Pest Commission for the Season of 1906-1907 (13 pages).

Circular No. 13.—Report Upon the Work of the State Crop Pest Commission. April, 1907 (11 pages).

Circular No. 14.—A simple Plan of Eradicating the Cattle Tick by the Pasture Rotation Method: Adapted to Use on the Average Louisiana Farm (4 pages).

Circular No. 15.—Fighting the Boll Weevil by Picking up the Infested Squares (4 pages).

Circular No. 16.—The Most Important Factor in Solving Boll Weevil Problem (4 pages).

CIRCULAR No. 18

OF THE

State Crop Pest Commission

OF

LOUISIANA

THE WHITE FLY
AND ITS TREATMENT

BY

ARTHUR H. ROSENFELD

ISSUED UNDER THE DIRECTION OF THE

STATE BOARD OF AGRICULTURE AND IMMIGRATION

CHAS. SCHULER, Commissioner

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BATON ROUGE:
THE DAILY STATE, OFFICIAL JOURNAL OF LOUISIANA.
1907.

STATE CROP PEST COMMISSION OF LOUISIANA.

ORGANIZATION.

Hon. Newton C. Blanchard, Governor of Louisiana.

Hon. Chas. Schuler, Commissioner of Agriculture.

Professor W. R. Dodson, Director, State Experiment Stations.

Wilmon Newell, Entomologist, State Experiment Stations.

Hon. L. S. Frierson.

Hon. B. W. Marston.

STAFF.

Wilmon Newell, Entomologist and Secretary.

Miss L. E. Renneker, Clerk and Accountant.

Arthur H. Rosenfeld, Assistant Entomologist, Fruit Insect Control and Miscellaneous Investigations.

C. W. Flynn, Jr., R. G. Tillery, Assistant Entomologists, Cattle Tick Eradication.

M. S. Dougherty, T. C. Barber, Assistant Entomologists, Cattle Tick Investigations and Experiments.

G. A. Runner, Assistant Entomologist, Nursery and Orchard Inspection.

T. C. Paulsen, C. E. Hood, Assistant Entomologists, Boll Weevil Investigations.

J. B. Garrett, Assistant Entomologist; located at North Louisiana Experiment Station, Calhoun, La.

Dr. C. E. Mauldin, Dr. Walter Sorrell, Dr. T. Byron Cracroft, P. P. Knowles, J. M. Beckham, J. E Baker, C. M. Davidson, C. L. Andrews, Inspectors, Cattle Tick Eradication.

[illegible] spraying orange trees for white fly, with bucket spray pump having extension rod attachment and extra long

State Crop Pest Commission

OF LOUISIANA.

CIRCULAR No. 18. JULY 15, 1907.

The Circulars of the State Crop Pest Commission are sent free of charge to all farmers and fruit growers of Louisiana who make application therefor.

The White Fly* and Its Treatment.

By ARTHUR H. ROSENFELD.

INTRODUCTION.

The white fly, or mealy wing, as it is sometimes called, is, in connection with the sooty mold of the orange which it indirectly causes, one of the worst enemies to citrus plants in Louisiana. It was first brought to the attention of entomologists in the orangery of the U. S. Department of Agriculture at Washington, D. C. It is not positively known where the original home of this little insect is, some well-known scientists inclining to the belief that it is a native of Florida, while other equally well-known authorities contend that the original habitat must be in Australia or Asia.

It is abundant in Louisiana from Baton Rouge southward. It is thought very probable that it was introduced into Louisiana during the New Orleans Exposition in 1885. Since that time it has spread considerably, and is now a very common insect in probably all of the orange-growing parishes of the State, with the exception of Cameron and Plaquemines. It has been reported from six states, namely, District of Columbia, Florida, Georgia, Louisiana, North Carolina, and Texas.

**Aleyrodes citri* R. & H.

DESCRIPTION.

Most fruit growers in the infested districts are familiar with at least the larval stages of the white fly. The life of the insect, as is the case with most insects, is divided into four distinct periods, viz., the egg stage, the larval or nymphal stage, the pupal or resting stage, and the adult or fly stage.

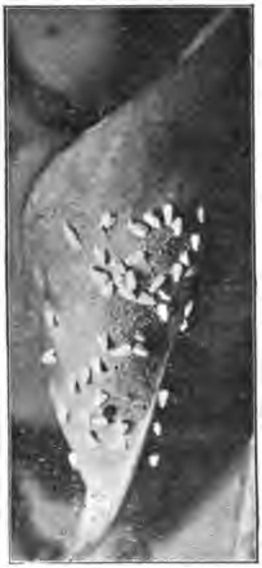

FIG. 2.—Adult white flies and their eggs on the under side of an orange leaf (After Gossard, Bulletin 67, Fla. Exp. Station).

The eggs are very small, being about one-one hundred and twenty-fifth of an inch in length, about four times as long as broad, and attached to the leaves by a slender stem. They are pale yellow when first laid, but gradually darken as the young insects develop within. When the egg is about to hatch, the little red eyes of the embryonic larva can be plainly seen through the egg-covering.

From the egg hatches a tiny, pale greenish-yellow insect about one-eightieth of an inch in length. This little larva sheds its skin (which process is known as "moulting") four times in the process of growth before it reaches the pupal stage, at which time it is about three-fiftieths of an inch in length and two-fiftieths of an inch in breadth. It is during the larval and pupal stages that these insects resemble scale nsects so closely. They are not really scale insects, but belong to a very closely related family (Aleyrodidae).

The pupal stage resembles the mature larvae so closely that it is difficult for the ordinary observer to distinguish them. The insect is about the same size at this stage as at the last, except that it is slightly narrower.

The adult has quite a different appearance. When the insect breaks its pupal case and comes forth as a mature insect it has undergone a wonderful transformation and in no particular resembles any of the former stages. From the comparatively helpless, flattened little creature, having almost no visible organs, there issues a beautiful little four-winged fly, the wings of which soon become covered with a fine waxy secretion, giving them their characteristic appearance, and suggesting the name of "mealy wing." When they first emerge they are a light orange-yellow in color, but within a couple of hours assume the mealy appearance. The female is about one-twentieth of an inch in length; the male somewhat smaller.

LIFE HISTORY.

The first brood of adult flies issues scatteringly through March, April and early May. They love closely sheltered groves and as a rule it will be found that well-planted open groves are not as badly infested as closely set, unpruned groves. The flies pair very soon after emergence and the females generally begin depositing eggs in from 12 to 30 hours. In case of cold weather, however, they may delay oviposition for several days. They do not, as a rule, lay their eggs in any certain position relative to each other, but this sometimes occurs. They always choose the under side of the youngest and most tender leaves, except in cases of bad infestation, when old leaves will be covered with eggs also. The eggs will generally be found thickest toward the center of the leaf. Each female lays from 17 to 25 eggs, depending upon the temperature, warm weather being conducive to prolific oviposition, and cold weather *vice versa*. Prof. Gossard calculated that the number of eggs on a single leaf taken from a grove at Myers, Fla., was 20,000, and this is a conservative estimate. This will serve to give some idea of the enormous reproductive capabilities of these insects.

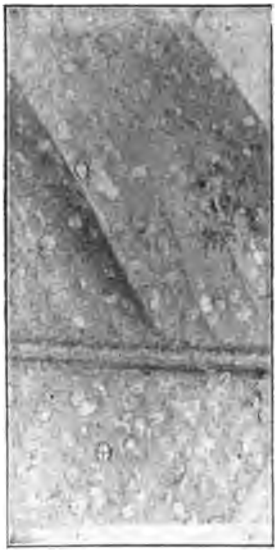

FIG. 3.—Larvae and pupae of white fly on the under side of an orange leaf (After Gossard Bul. 67. Fla. Exp. Station).

The eggs hatch in from three to twenty days, depending upon the temperature. It might be said here that in all insect, as well as in plant life, cold weather retards development.

The young larvae, when hatched, crawl about over the leaves and twigs for several hours before attaching to the leaves. Under normal summer conditions the insect will pupate in from twenty to thirty days after hatching, and the full grown fly will emerge in from ten to thirty days afterwards. We thus see that the life history of one brood, from the time that the egg is laid until the adult insect emerges, will range from forty to fifty days in the summer to six months in the winter.

When the adult insect is ready to emerge the pupal skin splits in the form of a cross, and the soft little fly comes forth. When they first issue the flies are damp and comparatively helpless, but in the course of an hour or two the body and wings harden, and the insects begin mating soon afterwards.

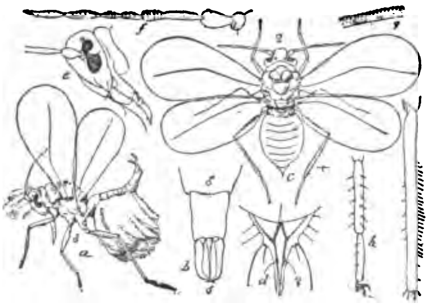

FIG. 4.—White fly (*Aleyrodes citri*); *a*, winged male insect, with enlarged view of terminal segments at *b*; *c*, dorsal view of winged female, with enlargements of ovipositor, head and antenna, wing margin, and leg at *d*, *e*, *f*, *g*, *h*, *i*, (After Riley and Howard, courtesy U. S. Dept. of Agriculture, Bur. of Entomology).

There are three broods each year with the possibility of a fourth in exceptionally warm and lengthy seasons. There is always, however, a certain amount of continuous breeding, so that all stages of the insect can generally be found at the same time upon a badly infested tree, except during the cold winter months.

NATURAL ENEMIES.

The only natural enemies of the white fly which show any likelihood of exerting much influence in holding this insect in check are several fungous diseases, known as the Red Ascheronia. the Brown Fungus, and the Yellow Ascheronia. Of these the first two have been introduced into Louisiana, and it is probable that in many cases, they will make spraying unnecessary in a few years. All of these fungi have done a great deal of good in Florida, numbers of the large orange growers there depending upon the fungi entirely for control of the white fly.

As yet we know little of these fungi in Louisiana, but there seems no reason why they should not be just as effective in this state as they are in Florida. The conditions in Louisiana, especially the extreme humidity which exists in all of the orange-growing parishes, are very favorable for the multiplication of fungi. We are now conducting at several points in the State, experiments with the Red Ascheronia and the Brown Fungus. In 1906 we introduced these fungi, obtained from the Manatee section of Florida, into orange groves at Lake Charles, New Orleans, Amite, Naomi, and Nairn, but, on account of the drouth of last season, most of the fungus died out. However in two places, notably at Lake Charles, and in a grove in Jefferson Parish, the fungi have become well established, and during the past winter killed about 95 per cent of the white fly upon the trees infected with the fungus. Using these two places as a source of supply, we are conducting more experiments with the fungi this year, and, with a favorable season, hope to get them well established in a number of places in the State.

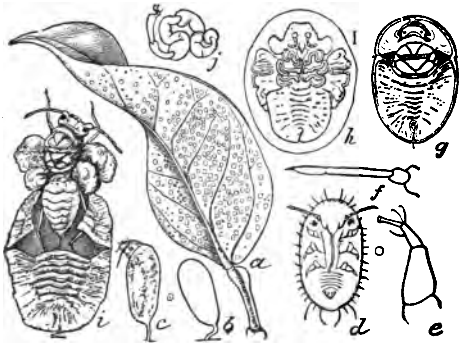

Fig. 5.—White fly (*Aleyrodes citri*); *a*, orange leaf, showing infestations on under surface—natural size; *b*, egg; *c*, same, with young insect emerging; *d*, larval insect; *e*, foot of same; *f*, larval antennae; *g*, scale-like pupa; *h*, pupa about to disclose adult insect; *i*, insect escaping from pupal shell; *j*, leg of newly emerged insect, not yet straightened out and hardened—all figures except *a* greatly enlarged. (After Riley and Howard, courtesy U. S. Dept. of Agriculture, Bur. of Entomology).

SOOTY MOLD.

Many orchardists have noticed a sooty or smutty appearance of their orange trees without knowing that this directly follows the attack of the white fly. The white fly is one of a class of insects which have the faculty of excreting, through the pores of their little bodies, a sweet substance called honey-dew. This honey-dew falls upon the leaves beneath the feeding insects, and becomes the growing place for minute plant organisms called fungi. The sooty mold of the orange is caused in just this manner. The spores of the sooty fungus, which in general function correspond to the seeds of higher plants, are carried by the wind or other natural agencies, and fall upon this honeydew. They soon germinate and begin to grow, gradually covering the entire upper surface of the leaf with a fine, black, filmy covering, which can often be rubbed from the leaf as if it were a piece of tissue paper. The fungus does its injury, not by destroying directly the essential juices of the plant, but by covering up the openings of the leaves and preventing the absorption of plant food from the air. Thus it is readily seen that by getting rid of the white fly one will at the same time rid the trees of a most unsightly and injurious disease.

SPRAYS.

While we cannot hope to *entirely* eradicate any insect from fruit trees, we can, by judicious spraying, so keep down the white fly that the injury from both the insect and fungus will amount to almost nothing. Either one of the following formulae will prove effective *if properly applied.* They are recommended by Prof. H. A. Gossard in Bulletin 67 of the Florida Agricultural Experiment Station Prof. Gossard's directions for preparation of these washes are as follows:

1.	Resin, pulverized	20 pounds.
	Caustic Soda, granulated, 98 per cent...	4 1-4 lbs.
	Fish Oil............................	3 pints.
	Water for final bulk..............	150 gallons.

"Ordinary commercial resin, such as is bought by the barrel in Florida, is satisfactory, and is best purchased in small packages, the entire contents of which can be used at once after opening, for this substance rapidly absorbs moisture from the air, and therefore loses its effectiveness if left exposed.

"Another formula which has given good satisfaction to some growers because of the convenience of quickly obtaining the materials without ordering them from a distance, and of keeping the soda indefinitely without special precautions is as follows:

2.	Resin	20 pounds.
	Caustic Soda (Star Ball Potash) pulverized	7 pounds.
	Fish Oil........................	3 1-2 pints.
	Water for final bulk..............	100 gallons.

* * * "As a smothering wash formula 1 is probably equal to 2, but its contact effects are less satisfactory. If the wash is to be used in summer the dilution is about right, but for winter use better results are secured by diluting to 100 gallons instead of to 150.

* * * "The details of preparation are the same no matter which formula is used. Procure a large iron kettle, a hog scalding vat is excellent, and another smaller kettle for hot water. If a large kettle of from twenty-five to forty gallons capacity is unavailable, a number of smaller ones can be used, the materials being divided between them as they are weighed out and measured. Heat in the large kettle thirteen or fourteen gallons of water, having previously placed the materials given in one of the formulae in the bottom. If the water is hot before the materials are put in, add the resin and fish oil first, and then the soda in small lots to prevent a sudden boiling over. Boiling is best continued for two or three hours over a hot but not too brisk fire. * * * Whenever there is a tendency for the liquid to boil over, subsidence can be quickly obtained if a pint or more of water from the water kettle, which is kept warm but not boiling, is added. Never add cold water while the wash is cooking if you desire results that are certain. Increase the quantity of solution by gradual additions of warm water until a stock solution of thirty gallons is obtained. For use, this is to be diluted to 100 or 150 gallons as called for by the formula used. The stock solution may be kept for a time and used as desired, but the wash is best used as fast as made. Any sediment or settling in the stock solution indicates that the cooking was incomplete and must be repeated. * * The stock solution should be strained before diluting it to remove any particles of trash that would clog the pump nozzle."

The Crop Pest Commission is now conducting extensive experiments in New Orleans, in co-operation with the State Experiment Stations, using twenty different spraying solutions for the control of the white fly and the purple scale so common on Louisiana oranges. We are trying to find the solution which is most efficient against both the white fly and the purple scale, thus combining the treatment for these two insects. The resin washes, recommended above, seem equally effective against both of these pests, and are the most effective sprays we know of at present. We hope to publish the results of these spraying experiments within the year.

In the treatment of the white fly it is very important to understand when to apply the sprays. Two applications should be made between December and the first of March, all fruit being removed before the wash is applied, in order to prevent burning. In the case of badly infested groves, three applications may be made with profit, at intervals of from ten days to three weeks, during this period. If these treatments are thoroughly made summer treatment will probably be unnecessary. If possible it is always best to avoid summer treatments of orange groves, as a wash which is strong enough to kill the insects is very likely to injure the fruit or foliage in the summer.

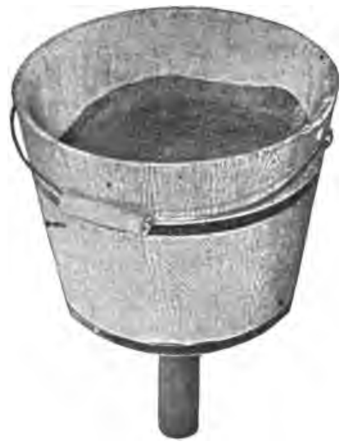

FIG. 6.—A serviceable home-made strainer for straining resin mixtures. Made by placing wire cloth in an ordinary water bucket and inserting a piece of gas pipe in the bottom. (From a photo by W. E. Britton, Conn. Exp. Station.)

SUMMER TREATMENT FOR THE WHITE FLY.

While, as pointed out above, there is no spray that can be used in the summer as a satisfactorily efficient agent against the white fly, still it sometimes becomes necessary to apply a wash of some sort in the summer in order to keep badly infested trees alive until winter treatment can be undertaken. Infestations are sometimes discovered in the summer which are so severe as to make it necessary for the owner to either treat at once or lose the trees. In such cases about three applications of the sulphur and whale oil soap mixture, recommended by Professor H. A. Gossard in Bulletin 67 of the Florida Agricultural Experiment Station, or of a fifteen per cent kerosene emulsion, will prove effective in holding the pest sufficiently in check to keep the trees alive until a stronger wash can be applied.

To make the sulphur and whale oil soap mixture, dissolve one quart of flowers of sulphur by boiling with ten pounds of whale oil soap in fifteen gallons of water, cooking well until all sulphur is dissolved, and then diluting to thirty-five gallons.

Kerosene emulsion is made from four pounds of whale oil soap (or good laundry soap), four gallons of water, and eight gallons of kerosene oil, as follows: Weigh the soap carefully and place with the water in a vessel over a fire, using a slight excess of water to allow for the evaporation incident to boiling. Fit a pump with a straight piece of hose, to which is attached a nozzle for throwing a straight stream 3-16 or 1-4 inch in diameter. Pour the oil into the vessel in which the pump is set, and when the soap is dissolved and the solution begins to boil, add it to the oil (AWAY FROM THE FIRE), and pump the whole vigorously back and forth into itself for at least ten minutes. The stream from the nozzle should be directed straight into the mixture, so as to agitate it all the way to the bottom. After a few minutes the oil and soap solution will be seen to combine, forming a thick, creamy solution, which, if properly made, will remain unchanged for some time. For a 15 per cent strength add, when ready to use, enough water to make 54 gallons. If a 20 per cent emulsion is desired, add water to make 40 gallons, and for a 10 per cent emulsion, add water to make 80 gallons.

Whale oil soap can be secured from James Good, Philadelphia, Penn., or from the J. Steckler Seed Co., Ltd., 516-520 Gravier St., New Orleans, La. The latter is the only firm in Louisiana which we know to handle this substance.

Summer spraying should never be commenced before the first or second week in June, as, previous to that time, the fruit is very susceptible to injury. If the trees are very badly infested, this spraying should be repeated about the middle of July, and again toward the latter part of August. Both of the above washes will kill a number of scale insects, and the sulphur and whale oil soap mixture is particularly valuable, as it materially assists in holding rust in check.

HOW TO SPRAY AND WHAT TO USE.

Too much emphasis cannot be placed upon the necessity of spraying *properly* against the white fly. As these insects live almost without exception upon the *under* surface of the leaves, it is absolutely essential that the spray be made to reach, as nearly as possible, all parts of this surface. At first it will be found a little difficult to do this thoroughly, but, after a little practice in handling the nozzle this will be a comparatively easy task. In order to cover every portion of the tree without the operator getting himself well covered with the spray, and also wasting quite a quantity, spraying should be commenced near the center of the tree and finished at the outside. Any pruning that is desired should be given before applying the wash, firstly, because the spray can be more easily made to reach all parts of the trees, and secondly, because of the direct saving in amount of spray which would otherwise be applied to the useless portions of the trees. It should be borne in mind that the object of spraying is to touch every single white fly with the wash, and that every white fly which is not so touched will simply act as a parent for another brood.

For the average large grove an ordinary barrel pump, mounted on a wagon or cart, will be all the outfit necessary, while in large commercial groves, power sprayers may be used to advantage; the wash, in this case, being best cooked by steam. For small groves and trees in yards the most economical and efficient apparatus is an ordinary bucket pump, such as is shown in Fig. 1, the price of which is about six or eight dollars.

In all cases the pump should be equipped with bamboo extension rods, except in the case of the bucket pumps, on which six foot iron extension rods will answer. All pumps should be furnished with a good length of rubber hose and Vermoral nozzles.

Special attention is called to the necessity of having a sufficient length of hose attached to all pumps. As usually sold, the length of hose attached to pumps is wholly inadequate, and the buyer should always specify that a certain length of hose shall be furnished before the pump will be accepted. For the bucket pumps about ten feet of good quality hose should be insisted on, while for the larger pumps about fifteen to twenty-five foot lengths will be necessary for best results. As usually sold, only about three feet of hose are furnished wth bucket pumps, which makes it impossible to do good work with them on anything larger than a small garden plant.

Two persons should always be employed when spraying trees, as it is impossible for one man to do a thorough job. One person should do the pumpng, while the other handles the nozzle.

Below are given the names and addresses of several manufacturers of reliable spray pumps, any of whom will furnish catalogues and price lists upon application.

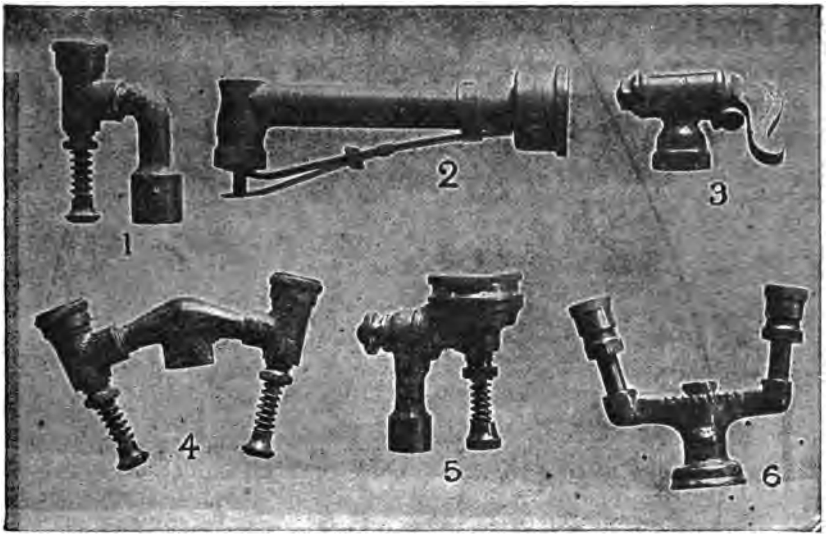

FIG. 7.—Common types of spray nozzles: 1, Vermorel; 2, McGowen; 3, Bordeaux; 4, Double Vermorel; 5, Mistry; 6, Double Spray-motor. (After Britton, Conn. Exp. Station Bulletin.)

Morrill and Morley, Benton Harbor, Mich.
The Deming Co., Salem, Ohio.
Goulds Manufacturing Co., Seneca Falls, N. Y.
Spray-Motor Co., Buffalo, N. Y.
Field Force Pump Co., Elmira, N. Y.
P. J. Berckmans Co., Augusta, Ga.
Beck and Gregg Hardware Co., Atlanta, Ga.
J. Steckler Seed Co., 516 Gravier St., New Orleans, La.

STATE CROP PEST COMMISSION REGULATIONS REQUIRING DEFOLIATION OF CITRUS NURSERY STOCK.

Section XI of the Rules and Regulations * of the State Crop Pest Commission of Louisiana, reads as follows:

"All orange, lemon, lime, sweet lime, kumquat, tangerine, and grape-fruit trees or plants sold or shipped within this State, or delivered within this State when shipped from another State or country, shall be completely defoliated. Shipments of such trees or plants, not so defoliated, intended for delivery within this State, when found in possession of any common carrier, corporation, firm, person, or agent, or when found exposed or offered for sale within this State, shall be subject to confiscation by the Entomologist or his assistants or inspectors."

Some dealers at first rather objected to this Regulation, principally upon two grounds, viz.,—that defoliated trees would not sell as readily as trees not so defoliated, and secondly, that defoliated trees will leaf out sooner than undefoliated trees, and would, therefore, be more liable to injury by frost. While both of these arguments have a certain amount of validity, the arguments for the other side may be summed up in a few words by saying that the chances for benefit under this Regulation are so much more numerous than the chances for injury, that it would be almost foolish not to have this Regulation. Besides this, when a customer is assured that his trees, when leaved out, will be clean and green instead of covered with the unsightly smut, there should be very little difficulty in selling the trees.

Naturally, in an infested region, the trees, even if defoliated, will sooner or later become infested, but they will get a much stronger growth before this infestation than they otherwise possibly could.

It is very doubtful after all, if defoliation renders a tree more subject to death by frost, and there is even good reason for supposing that a defoliated tree is really more dormant than one upon which the leaves are performing their normal function and thus keeping a certain amount of sap in circulation. The

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*Issue of July 1, 1907. (See Circular 17 of the Commission.)

experiments of the Audubon Park Experiment Station bear out this conclusion. A few years ago Mr. Blouin had a defoliated tree to stand a temperature of 15 degrees at Batón Rouge, while trees from the same lot and planted at the same time, but not defoliated, were killed to the ground.

It has now been several months since this "defoliation Regulation" was placed in effect by the Commission, and New Orleans nurserymen report to us that not only are shipping and handling expenses reduced by defoliating the citrus trees, but that their customers, realizing the benefits following defoliation, willingly accept defoliated trees in preference to others.

SUMMARY.

1. The white fly is one of our most common and injurious insects on citrus plants. Its original habitat is not known with certainty. It was first noticed in the orangery of the U. S. Department of Agriculture. It is thought that it was first introduced into Louisiana during the New Orleans Exposition in 1885. It is now known in six States.

2. The life of the insect is divided into four distinct stages, viz., the egg stage, the larval stage, the pupal stage, and the adult stage.

3. Temperature influences greatly the length of different stages, and therefore probably the number of generations per year. Under normal conditions the insect will pupate in from twenty to thirty days after hatching, and the full grown fly will emerge in from ten to thirty days afterwards. There are generally three broods, but with an exceptionally warm summer and fall there may be four.

4. The Red Ascheronia, Brown Fungus, and the Yellow Ascheronia, three fungi, are doing a great deal toward holding the white fly in check in certain localities in Florida. These fungi are being introduced into Louisiana by the State Crop Pest Commission.

5. Sooty mold is caused by fungi breeding in the sweet excretions of the white fly. This sweet excretion, or honey-dew,

falls upon the upper surface of the leaves, and the sooty mold is there most abundant. When the white fly is disposed of, the sooty mold also disappears.

6. The resin washes recommended by Prof. H. A. Gossard of the Florida Experiment Station have thus far proven the most efficient sprays against the white fly. Experiments are now being conducted at the Audubon Park Experiment Station with different sprays for this insect and the purple scale.

7. Complete defoliation of all citrus nursery stock before sale or shipment in Louisiana is required by the Regulations of the State Crop Pest Commission, and prevents distribution of the white fly to localities still free from the pest.

State Crop Pest Commission
OF LOUISIANA.

CIRCULAR No. 19. AUGUST 1, 1907.

The Circulars of the State Crop Pest Commission are sent free of charge to all farmers and fruit growers of Louisiana who make application therefor.

Protecting the Cotton Crop Against the Boll Worm.

PLANTERS ARE ADVISED TO APPLY PARIS GREEN BETWEEN AUGUST 5TH AND 15TH.

By Wilmon Newell.

Earlier in the season articles were sent out from this office advising the cotton planters to protect their cotton crop against the boll worm (not boll weevil) by planting trap rows of corn through the cotton fields at such time as to bring this corn into the silking stage early in August. This was to attract the early August brood of moths and cause them to deposit their eggs on this trap corn instead of on the cotton.

As supplementing those recommendations and to further protect the crop against the attacks of this pest we now advise the planters to make a light application of Paris green to the cotton between August 5th and 15th. This recommendation can be adopted to advantage by the farmers who did not plant trap rows of corn in their cotton fields as well as by those who did. The object of this application of Paris green at sent time will be made plain in the following paragraphs.

the minds of some, considerable confusion exists regarding the mportant cotton insects known as the boll weevil, the boll worm e cotton caterpillar: To combat these insects intelligently and practical advantage of the local conditions on his own farm the must distinguish carefully between these three different insects eir habits.

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The boll weevil is the little beetle which has entered Louisiana from Texas since 1903 and is each year gaining territory to the eastward. The adult beetle punctures the squares with its beak and feeds, through this little opening, on the pollen inside of the square. The eggs of the female are deposited within the square through similar small openings made with the beak of the insect, and the "grub" which hatches from the egg develops inside of the square, where it cannot be reached with poisons.

The boll worm is the larva or "worm" of a moth (resembling the so-called "candle-flies" which are attracted to lamps at night). The moth deposits its eggs on corn, cotton and other plants and these eggs hatch into the small boll worms which in early life wander where they please and feed here and there, instead of on the inside of any one square or boll. The large, round holes found eaten into green bolls in August and September are made by these boll worms. This insect has been in the cotton belt since before the Civil War.

The cotton caterpillar, or leaf worm, is also the larva of a moth, but a very different insect from the boll worm. Instead of eating into the bolls the leaf worm "strips" the leaves from the entire plant and is most abundant from July on toward frost.

To clearly understand why an application of Paris green at the present time will be effective against the boll worm it is necessary to review briefly the development of this insect. As with most of the six-footed creatures, the boll worm passes through four stages in its development, the insect in each stage being designated as follows: The egg; the larval or "worm" stage, in which the insect feeds and attains its growth; the pupal or chrysalis stage (which corresponds to the "cocoon stage" of a butterfly), in which the insect takes no food, is quiet and undergoes its change to the adult insect, and finally the adult or moth stage.

There are four, and sometimes five, generations of the boll worm a year, appearing as follows: The winter is passed by the pest in the pupal stage in cells a few inches below the surface of the ground. From these the moths emerge in spring and deposit their eggs in the growing tips of field corn, which is then from 12 to 18 inches high. The worms ("first brood") from these eggs feed in the tip of the corn plants and cause the leaves to have ragged holes in them when they unfold. These worms mature and enter the earth, pass through the pupal stage and reappear as adult moths about the time the field corn is in silk. Eggs are deposited on the silks and the resulting worms ("second brood") eat the milky kernels of the ear. When mature they, like their ancestors, enter the earth, pass through the pupal stage and appear as moths in early August. By this time the field corn is ripened and hard and not attractive to the moths, so they turn to their second choice of food plants, cotton, as the place to deposit their eggs. Thus we come to see why this insect rarely appears in large numbers in the cotton field until in August and September. The eggs laid on the cotton plants soon hatch into minute boll worms ("third brood") and these, during the first few days of their life, crawl about over the cotton plant, feeding here and there upon the tender shucks, leaves and exterior parts of the plant. It is just at this stage that they can be successfully poisoned. As they grow older, in the latter part of the month, they bore deep into the green bolls and then for the most part do their work feeding beyond the reach of poison.

The fourth brood also develops in the cotton fields.

The proper time to apply the poison is between August 5th and 15th, preferably between the 5th and 10th. It should be applied in the same manner as for the leaf worm, by placing the poison in cloth sacks attached to the end of a pole and this carried between the rows by a laborer on horseback. One pound of the poison to the acre is amply sufficient and one application is enough (unless a rain follows immediately in which case another application should be made promptly). While this poisoning will not kill all of the boll worms it will destroy enough of them to make a perceptible difference in the yield. Each of these boll worms, when half-grown, can destroy several locks of cotton a day, therefore it is easily seen that a pound of prospective cotton can be destroyed in a short time by even a limited number of the worms.

This early August application of Paris green will also destroy any leaf worms that may be commencing work in the fields, and thereby further protect the crop. The leaf worms should be held fully under control until about September 1st. After September 15th it is better (in boll weevil infested neighborhoods) to let the leaf worms strip the cotton plants, than to poison them. By their work late in the season the leaf worms open up the dense foliage and permit the sunlight to reach the lower bolls and hasten their maturity and opening.

When the leaf worms are abundant during October and November and completely defoliate the cotton plants they are highly instrumental in reducing the available food supply (green leaves and squares) of the boll weevils. In addition to this their destruction of the late forming squares (in November) cuts off the breeding place for the last brood of boll weevils, thereby greatly reducing the number of weevils which survive until frost to enter winter quarters. Thus it happens that, while the leaf worm is an enemy during midsummer, it becomes in October and November a most valuable ally in the fight against that greater enemy the boll weeevil. During July and August only enough

Paris green should be used to protect the cotton from the leaf worms; during the balance of the season they should be encouraged and permitted to increase as much as possible.

SUMMARY.

1. The third brood of boll worms makes its appearance in early August and the small worms, just hatched from the egg, feed upon the outside of the squares, bolls and leaves, where they can be reached with poison.

2. A light application of Paris green should be made to the cotton between August 5th and 15th, to destroy these young boll worms, this application to be made in the manner customar ly employed in applying Paris green for the leaf worm.

3. This application will also be effective against any leaf worms now present in the field, and thus accomplish a double purpose.

4. Poison should not under any circumstances be applied to the cotton after September 15th, as it is highly desirable that the leaf worms should increase as much as possible late in the season and, by stripping the cotton, cut off the food supply of the boll weevils, thus reducing the number of the lattter which will enter winter quarters when frost arrives.

Baton Rouge, La., August 1st, 1907.

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CIRCULAR NO. 20

OF THE

STATE

Crop Pest Commission

OF LOUISIANA

THE INSECT ENEMIES OF THE BOLL WEEVIL

A Brief Account of Their Nature and How They Destroy the Weevil.

BY

W. D. Hunter, Wilmon Newell and W. D. Pierce

Issued Under the Direction of the State Board of Agriculture and Immigration.

CHAS. SCHULER, Commissioner.

BATON ROUGE:
THE DAILY STATE, OFFICIAL JOURNAL OF LOUISIANA.
1907.

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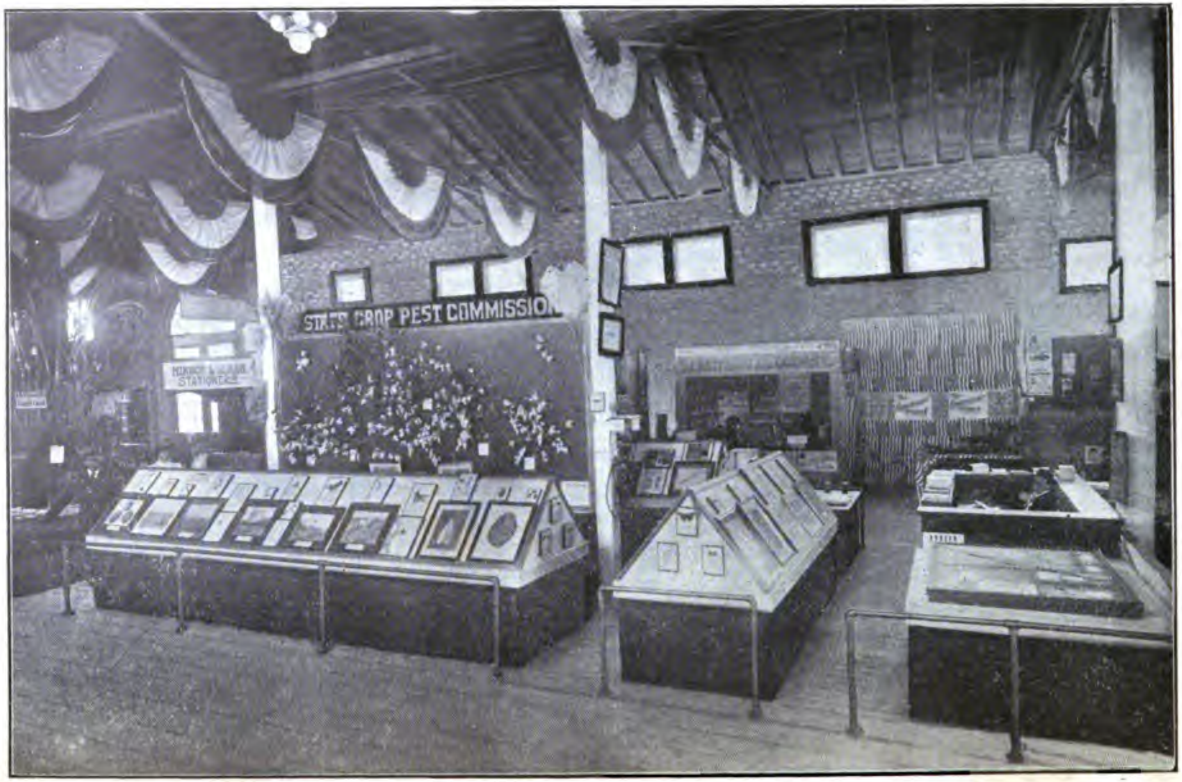

FIG. 1. Exhibit of the State Crop Pest Commission at the Louisiana State Fair, Shreveport, La., Oct. 5 to 13, 1907.
(Awarded a Diploma of Excellence by the State Fair Association.)

State Crop Pest Commission
OF LOUISIANA.

CIRCULAR No. 20. DECEMBER, 1907.

The Circulars of the State Crop Pest Commission are sent free of charge to all farmers and fruit growers of Louisiana who make application therefor.

The Insect Enemies of the Boll Weevil.

A BRIEF ACCOUNT OF THEIR NATURE AND HOW THEY DESTROY THE WEEVIL

By W. D. Hunter, Wilmon Newell and W. D. Pierce.

INTRODUCTORY.

There are many means of controlling injurious insects, such, for example, as the use of sprays or poisons and the destruction of the unused portions of the crop. These methods may be said to be direct ones inasmuch as they aim at the actual killing of the insects and are not devices for circumventing them. In the case of the cotton boll weevil the fall destruction of the plants and gathering of the infested squares are the only direct means which have been found at all effective. The other steps in the control of this insect, such as through preparation of the soil, early planting, intelligent fertilization, and extra good cultivation, are supplementary to the main step of destroying the stalks each fall. Although these direct methods are effective they involve more or less trouble and expense. A better method consists in the utilization of the agencies which are provided by nature. This circular deals with the work now under way in co-operation between the Crop Pest Commission and the Bureau of Entomology of the United States Department of Agriculture, in devising means for obtaining the best possible results in the utilization of such natural agencies affecting the boll weevil as can be controlled more or less easily by man. It is hoped that these methods will eventually assist greatly in the warfare against the boll weevil. At the present time, however, it must be understood that this circular deals with methods which have not yet been put into practice on a large scale, and its publication is intended to inform those interested of what work is under way. In the meantime, of course, no farmer should fail to make use of the expedients to be resorted to in raising cotton where the boll weevil is present that have been brought out in the publications of the United States Department of Agriculture and of the State Crop Pest Commission.

INSECTS ATTACK ONE ANOTHER.

In a state of nature most insects are held in control by other insects which prey upon them. When an insect succeeds in getting away from its native enemies or is artificially introduced into a country where there are no insects to attack it, damage must be expected if a cultivated crop is attacked. When the cotton boll weevil became established in the United States it was free from all its tropical enemies and rapidly moved northward and eastward, almost without check. This condition could not last. There are everywhere multitudes of little insects which can not live on vegetable matter and which must have insect food. From time to time some crisis has happened in the existence of one or another of these little creatures and it has had to try strange food. It is but natural that many of them have been attracted to such a common insect as the boll weevil.

PREYING INSECTS.

These minute insect friends do their work in several ways. At present the most important of them are the little fire ants (so-called on account of their sting, which gives a burning sensation), which abound in the cotton fields, exploring every inch of ground and plant in search of insect prey. They are very active little creatures and seem to have learned to recognize the presence of boll weevils in the fallen squares. When one is located the discoverer summons a squad of her fellows and they gnaw their way into the square and remove the weevil entire or in pieces to their nest, where it is quickly consumed. On account of this habit these little ants are called PREDACEOUS or PREYING insects. One of these fire ants is shown, greatly enlarged, in Figure 2. This little ant, which occurs all over Texas and Louisiana, should not be confused with the Argentine or so-called "New Orleans" ant, which has become such a household pest in Southern Louisiana.

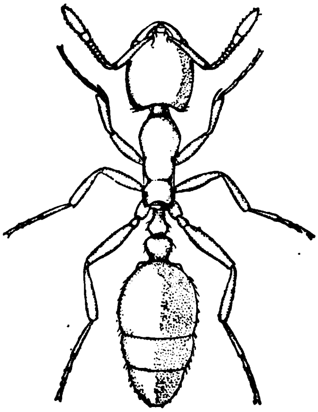

FIGURE 2. A fire ant (*Solenopsis geminata*), which is an important enemy of the boll weevil (After Hunter & Hinds. Bur. of Entomology, U. S. Dept. of Agr.

PARASITIC ENEMIES OF THE WEEVIL.

The most interesting enemies of the boll weevil are about fifteen species of very small wasp-like insects, which fly around the cotton fields until they find a cotton square with a live weevil larva in it. Then they lay an egg in the square on the weevil, and fly to another square to lay another egg. They have a sharp apparatus called an "ovipositor," for depositing their eggs, with which they can easily pierce the square. These eggs hatch in three or four days and the little grubs commence to feed on the boll weevil larva. The weevils die and their enemies grow and finally develop into full grown insects like the one which laid the eggs. One of the most important of these wasp-like parasites is shown, greatly enlarged, in Figure 3.

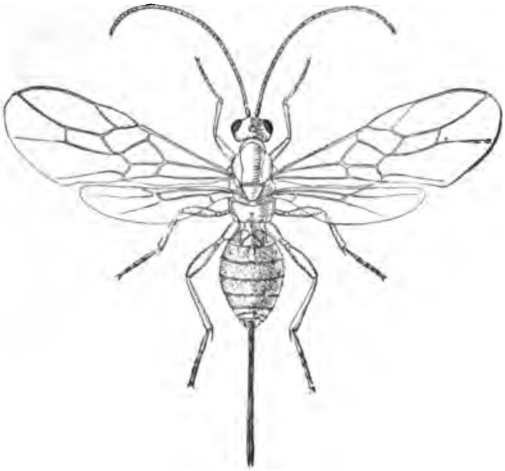

FIG. 3. One of the important wasp-like parasites (*Bracon mellitor*) of the boll weevil Notice the long ovipositor with which the weevil-infested square is punctured and through which the parasite's egg is forced into contact with the weevil larva. (After Hunter & Hinds, Bul. 51, Bur. of Entomology, U. S. Dept. of Agriculture.)

When an insect lives like this, at the expense of another insect, it is called a PARASITE, and the insect which suffers is called the HOST. Not all parasites kill their host immediately, but their attack is finally fatal. All insects with the parasitic habit are permanently so and need never be feared as enemies of any field crop. They are always the friends of the farmer.

It has already been intimated that the BOLL WEEVIL PARASITES ARE NATIVE INSECTS. Ordinarily they attack other species of weevils which breed around the cotton fields in different weeds. Most of these other weevils are harmless for two reasons: First, they are held down by their enemies, and, second, they attack and hold down more or less the weeds which are such nuisances.

It frequently happens that the parasites become so numerous on one of these native weevils that finally the supply of food for their young gives out. Under such circumstances they find the closely related boll weevil and deposit their eggs on it. EACH YEAR SEVERAL NEW SPECIES ARE ADDED TO THE BOLL WEEVIL ENEMIES by this process, in different parts of the infested region.

Of the fifteen or sixteen parasites referred to, **all** do not occur throughout the **entire** weevil-infested area. In some localities three or four kinds of them are found, in others perhaps five or six kinds, etc. One of the lines of work being conducted by the entomologists is that of distributing these parasites over the entire weevil-infested section so that **every** locality will have, if possible, **twelve or fifteen** kinds of parasites attacking the weevil **instead of three or four.** Some of the co-operative experiments in introducing parasites that have been made in the past season near Shreveport have proved very encouraging and have demonstrated the practicability of this plan.

If there were no checks in the development of our great pest there would not be a single lock of cotton produced in the infested region. Fortunately there are many checks. In the first place the planter can so manage as to destroy myriads of weevils in the fall. and also so as to kill many hibernating weevils in their winter quarters. He can plant early and produce some crop before the weevils catch up with his cotton. He can plant so that the sun will get in its full effect. It is now known that the intense heat from direct exposure to the sun is responsible for the death of 32 per cent of all weevil stages. This control in some places under favorable conditions reaches almost 90 per cent. At the same time the little fire ants (see Figure 1) destroy 20 per cent of all the weevil stages, and the parasites kill 10 per cent. This means that THROUGHOUT THE SUMMER 62 PER CENT OF ALL THE WEEVIL STAGES ARE BEING KILLED. There are many favorable conditions which increase the work of one or another of these agencies. The figures just given are for 1907, and show a decided increase over 1906.

One of the purposes of the boll weevil investigation is to bring about a knowledge of the weak points in the life history of the insect so that every planter will know when and where to strike in order to accomplish the best results. IT IS WITHIN THE POWER OF EACH FARMER TO LESSEN THE DAMAGE BY THE WEEVIL, but much more is accomplished by the natural agencies referred to.

The object of this circular is to explain the nature and possible value of the parasites, which are more difficult to understand than are the artificial methods of controlling the weevil. Very little can be done at present in assisting the ants. They will take care of themselves. There are no reasons why the PARASITES, however, can not BE INCREASED and raised above the third rank as boll weevil destroying agencies.

ASSISTING THE PARASITES.

The planter who desires to offer every possible inducement to the parasites will plant his cotton early so that the first spring brood of parasites can start on the boll weevil instead of some other neighboring species of weevil. He will PLANT his cotton IN WIDE ROWS and use every device to insure plenty of sunlight in the entire field. These little creatures need heat and light and work best in the sunny fields, thus adding to the direct effect of the sun itself.

When it can be done without taking labor from the necessary field operations it is a good plan to pick up infested cotton squares and place them in large cages in the field, a plan which was first brought prominently to the attention of the Louisiana planters in Circular No. 15 of the Crop Pest Commission, published early last June. These cages may be of common wire screen, 14, 16 or 18 meshes to the inch. Some weevils will escape through the coarser meshed wire, and all of the parasites will. Even if only half of the weevils were held in and all of the parasites escaped it can readily be seen that the proportion of parasites to weevils in the field would be greatly increased. The squares should be dried a little before placing in the cages or at any rate scattered lightly. They should not be packed, for then the moulding and heating would destroy the parasites. Cages placed in various parts of the field will bring up the parasitic control of the weevil uniformly.* Immediate results must not be expected. Owing to their small size the parasites will rarely be seen by the farmer even when they are abundant and doing great work. The benefits are actual but hard to demonstrate without very careful examinations.

As has been shown, the common weeds around the fields contain many parasites of other weevils. It is possible BY CUTTING these WEEDS to FORCE the PARASITES TO ATTACK THE BOLL WEEVIL. An attempt of this kind in July on the experimental farm of the Bureau of Entomology at Dallas, Texas, resulted in increasing

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*Such cages need not be complicated or expensive. Any *tight* box or barrel, with top or side tightly covered with the wire cloth, makes a good cage.

the work of one parasite species from 2 per cent to over 30 per cent on weevils in dry hanging squares. The cutting only took two or three hours and the result was worth while to say the least. Our recommendation is, therefore, that whenever possible the weeds along the edges of the cotton fields or on useless ground adjoining the fields, be cut early in July and again early in August. There might or might not be parasites in these weeds, but there are many other cultural reasons why the weeds should be cut, and if by so doing the parasites are increased, so much the better.

All of the foregoing shows what may be done by each planter. The results will not be uniform, but in no case can they be entirely negative.

The work of the entomologists will necessarily be devoted to attempts at introducing new parasites and causing a more general distribution of each parasite species, in devising the best means of so doing, and in obtaining a complete knowledge of these creatures which must be the basis for their practical utilization.At the same time the farmer must be counted on to assist nature in controlling the weevil by aplying such measures as the scientific investigations show to be effective.

Baton Rouge, La., December 19, 1907.

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State Crop Pest Commission
OF LOUISIANA.

CIRCULAR No. 21. JANUARY, 1908.

The Circulars of the State Crop Pest Commission are sent free of charge to all farmers and fruit growers of Louisiana who made application therefor.

REPORT

UPON

THE ERADICATION OF THE CATTLE TICK IN LINCOLN AND CLAIBORNE PARISHES.

By WILMON NEWELL and C. E. MAULDIN.

For a number of years the cattle tick problem has engaged the attention of educators and of the progressive farmers and cattle raisers of the South, but it was not until recently that a satisfactory solution of this problem seemed possible.

When it was determined that cattle could be artificially immunized against the deadly Texas fever, transmitted by this small parasite, the cattle raiser received new hope and many breeders set about at once to import registered stock from north of the tick belt to breed up their scrubs, but it was found by thorough tests, extending over a number of years, that artificial immunization could be practiced only by the skilled, and even then at considerable risk. While the practical application of this protective immunization failed to give the general relief its advocates desired, it served a purpose in awakening an interest in cattle raising and in bringing to the attention of the Southern farmers the importance of this neglected industry. It also acted as a stimulant to investigation along other lines which developed the pasture rotation and other methods of tick eradication advanced by the State Experiment Stations and by the State Crop Pest Commission. Congress, realizing the practical appli-

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cation of these methods to general conditions and the vast importance of this work, now makes an annual appropriation to assist the Southern States in their crusade against the tick pest.

These appropriations are placed to the credit of the U. S. Department of Agriculture for distribution among the various tick-infested States in proportion to the amount which each State gives toward the cause from its own means. In other words, help is extended only to the States which help themselves.

The Experiment Stations and the Crop Pest Commission, knowing the urgent need of this work in Louisiana, arranged last June with the Bureau of Animal Industry for active cooperation in this movement, and the work was immediately inaugurated in Lincoln and Claiborne Parishes, a force of State and Federal employes being at once organized and assigned to duty.

While the tick-eradication work is based upon facts determined by scientific investigation, it is at the same time conducted in the most practical manner. With a view to presenting the work to every cattle owner in the two parishes, progressive farmers were employed, trained and then assigned to their respective communities for duty. These men visited each farmer, on his own farm, for the purpose of considering his conditions and advising him as to the methods best suited to his conditions for eliminating the tick pest. Each farmer was also directed and assisted by the inspector in carrying out these plans. An expert was also assigned to each parish to assist and direct the practical men and to meet the farmers at their gatherings to engage in formal discussions regarding the nature and advantage of the movement. In addition to this, a liberal distribution of literature bearing on the subject has been made and a number of lectures have been delivered by members of the Experiment Station force. The farmers' attention has also been directed to the importance of improving and increasing their herds along proper lines as a means of making crop diversification profitable, valuable suggestions being given in this connection.

Since the work began last June 4,000 farms have been visited once by the inspectors and 2,258 a second time; 27,135 head of cattle have been inspected once and 16,599 re-inspected, a total of 43,734 cattle having been examined and methods outlined for freeing them of the ticks. Upon the first inspection 97 per cent of the cattle were found infested with ticks. While at the present time a large per cent of the cattle are still infested yet it is estimated that the work is more than half completed, as the farmers are thoroughly instructed in the methods of tick eradication and a healthy sentiment exists in favor of a complete and lasting elimination of the pest.

As a means of protecting the cattle in the tick eradication territory from a fresh infestation of ticks, the Commission maintains a quarantine against ticky cattle from adjoining parishes and only tick-free cattle are admitted. The Federal Government, in recognition of the splendid results secured, has already placed a protective quarantine about Lincoln and Claiborne Parishes. This quarantine admits only tick-free cattle from Arkansas and other States. As the work progresses provisions will be made for inspected cattle being shipped at all times to any market in the United States. This is a privilege never yet allowed the Louisiana cattle raiser, his cattle having been disposed of at home, at a market below the national quarantine line, or consigned to the quarantine pens of the Northern markets, where they were sold to a non-competitive trade for immediate slaughter only.

It is estimated by experienced shippers that ticky cattle, sold for slaughter only, bring from 50 cents to $1, per one hundred pounds, less than cattle which can be disposed of for breeding, feeding, grazing or other purposes. This is a difference of from $120 to $240 on each carload of 24,000 pounds, and represents that much gain on every car of cattle shipped from tick-free territory over cattle which are tick-infested, everything else being equal. Because few cattle are shipped to northern markets it is erroneous to suppose that the price of our stock is not affected by the tick, for the price of cattle is as certainly fixed by the large markets as the price of cotton, wheat or bacon; and our cattle will bring at home, from the local butcher, just what they will sell for on the large markets, less the expense of shipping and handling. Hence, tick-free cattle will bring from one-half to one cent per pound more at home than ticky cattle or some one will ship them to the Northern markets.

Averaging the cattle (27,135 head) of Lincoln and Claiborne Parishes at the low weight of 300 pounds each, and estimating the net gain as a result of eliminating the tick at 50 cents per hundredweight, the immediate increased value of the cattle alone means $40,702.50 to the farmers of Lincoln and Claiborne Parishes; and, when the opportunities which are opened to a tick-free community in the way of unhampered importation of registered stock to breed up the scrubs, the feeding of grass and farm by-products at a greater profit, the increased fertilization of the soil, the enhanced value of farm lands and the encouragement of the best class of immigrants are taken into account, this amount is seen to represent but a very small part of the benefit accruing to the farmers as a result of this work.

While the increased price of our scrubs will, more than ten times over, pay the cost of tick eradication, this is by no means the sole aim of the work, for it is the purpose of the movement to encourage and aid the farmers in their efforts to increase and improve their herds, as well as to make an improved live stock industry possible.

In the past there have been many movements in the South for the betterment of general farming conditions, but there has never been a more timely one for Louisiana than the present effort to eradicate the tick pest. The ravages of the boll weevil make cotton growing profitable only upon the best soils and only by the best methods of cultivation. The poor lands must either be left idle or fertilized. If fertilized the cow must be looked to for aid, but the cow cannot be a profit producer in the presence of the tick, except in the hands of a very few. Therefore, the logical thing to do is to exterminate the tick and foster cattle raising that the inroads of the boll weevil upon the cotton crop may be counterbalanced as far as possible.

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E. J. Wickson.

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**Insure a Good Crop of Cotton Next Year By Destroying the Boll Weevils This Fall.
This Circular Tells How.**

State Crop Pest Commission
OF LOUISIANA.

CIRCULAR No. 24. AUGUST, 1908.

The Circulars of the State Crop Pest Commission are sent free of charge to all farmers and fruit growers of Louisiana who make application therefor.

DESTROYING THE BOLL WEEVILS BEFORE THEY ENTER HIBERNATION.

WILMON NEWELL.

There is a way to solve the boll weevil problem. It has been recognized by the U. S Department of Agriculture and by the State Crop Pest Commission for several years and has been repeatedly called to the attention of the cotton planters Those who have followed the recommendations in this regard have made good crops of cotton as a result. It is because of the extreme importance of the step referred to and because it is absolutely essential to a successful campaign against the boll weevil, that we again take the opportunity of placing it clearly before the farmers of Louisiana.

If any one thing has been conclusively proven, by the years devoted to a careful and scientific study of the boll weevil, it is that *those weevils which* successfully *survive the winter* are the *ones which mature latest in autumn.*

The boll weevil problem can be solved by picking out the cotton as soon as it opens and destroying the cotton plants immediately thereafter. This is the key to solving the weevil problem; it is the one all-important step that means success. It is by far the most important part of the cultural method of fighting the weevil. Thorough preparation of the soil before planting, the use of early-maturing varieties, thorough cultivation of the crop, the use of poison, and the picking up of fallen squares, all are but steps accessory to the early fall destruction of the cotton plants and *all* of these auxiliary steps combined are *not as effective as fall destruction* of the cotton plants *alone.*

The farmer plants seed of an early-maturing variety, he uses fertilizer perhaps, and he cultivates thoroughly and well in order to make an early crop. So far, so good; but if he fails to follow up these measures with the early fall destruction of the cotton plants he loses the advantage gained and *fails at the critical point* in the battle with the weevil. Early fall destruction of the cotton plants is not only possible and practical, but it is *profitable* and it *does* solve the boll weevil problem, as will be shown below.

Early fall destruction of the cotton plants is effective for three reasons: First, it results in the destruction of thousands upon thousands of boll weevil eggs, larvæ and pupæ, which are in the squares and green bolls at the time of this destruction; secondly, many adult weevils, clustering upon the small green bolls, are destroyed by the fire, and, finally, the food supply (green cotton foliage, squares and green bolls) of the adult weevils is cut off entirely, causing the death by starvation of a very large percentage of them before the time arrives for them to enter their winter quarters.

A PRACTICAL DEMONSTRATION.

One of the most convincing proofs of the success of this fall destruction of the cotton plants was secured from an experiment carried out during 1906 and '07 by the Bureau of Entomology, U. S. Department of Agriculture, in Calhoun County, Texas. About 400 acres of cotton were grown in the vicinity of Olivia, in that county, and no other cotton was grown nearer than 30 miles. The Olivia section had been thoroughly infested by boll weevils for several years. By special arrangements, made with all of the planters in that section by the Bureau of Entomology, the cotton plants were uprooted and burned during the first ten days of October, 1906. The following year the prevalence of weevils in the Olivia locality, as well as in the nearest cotton-growing section where the cotton plants had not been destroyed in the fall of 1906, was noted. Up to May 1, 1907, but one weevil was found in the 400-acre area at Olivia, while in the check fields, 30 miles away, where the stalks had not been destroyed the previous fall, the weevils were so numerous that practically every square was being destroyed by May 1st. Examinations made in the two localities in August, 1907, showed an average of ten bolls per plant in the fields at Olivia, and an average of only three bolls per plant in the locality where the plants had not been destroyed the previous autumn. For these details we are indebted to Dr. L. O. Howard and Prof. W. D. Hunter of the Bureau of Entomology, who have also furnished us the records of production in the two localities mentioned.

At Olivia, where the plants were destroyed by the farmers between October 1 and 10, 1906, the crop of 1907 averaged 615 pounds of seed cotton per acre. In the area where they were not thus destroyed the 1907 crop averaged only 225 pounds of seed cotton per acre, although the soil in the latter area is much richer and is better cotton land than at Olivia, and ordinarily produces about 35% more cotton per acre.

The farmers of Olivia therefore secured at least 130 pounds of lint and 260 pounds of cotton seed per acre as a reward for destroying the plants in the fall of 1906. Calculating the value of this increased production at 10 cents per pound for lint and $12.00 per ton for seed, this increase in the crop amounted to $14.56 per acre, or about twenty-nine times what it cost to destroy the stalks the preceding fall.

A LOUISIANA DEMONSTRATION.

The weevil situation in Louisiana the past spring (1908) has proven a beautiful demonstration of what effect such an early fall destruction of cotton plants has upon the abundance of boll weevils the season following. On November 13, 1907, a severe freeze visited most of the northern parishes, completely destroying squares, green bolls and foliage on the cotton plants. *Nature herself destroyed the cotton plants early in the fall.* Now as to the results: In the northern parishes, where the destruction of all green cotton was complete, the boll weevils were very scarce the past spring, so scarce in DeSoto Parish even, that the newspapers reported that the boll weevil had disappeared, and it is said upon good authority that the cotton acreage in that parish was this year considerably increased. Farther south in the State, where the frost of November 13, 1907, was less severe, more boll weevils survived the winter and a steady increase in the number of hibernated weevils was noted as one moved southward. In parts of Avoyelles and Rapides parishes, where there was no destruction of cotton by the frost of November 13th last, the hibernated weevils were more abundant the past spring than we have ever seen them anywhere, either in Texas or Louisiana, there being in some cotton fields from 2,000 to 6,000 adult weevils per acre before even the first squares appeared on the plants.

At the present writing a vast difference can be seen in this year's crop where the plants were completely destroyed by frost last November and where they were not. But little complaint of severe weevil damage has been received from the former localities, while in the latter the damage being done by the weevil will amount in some cases to 75% (or more) of the crop. What more convincing proof, that the early fall destruction of the cotton plants will *solve* the boll weevil problem, could be asked for?

THE SITUATION IN THE RED RIVER VALLEY.

The disastrous overflow of June and July greatly reduced the cotton acreage in the Red River Valley of Louisiana. So great was this reduction that comparatively few fields of cotton remain in the overflowed districts. There is labor amply sufficient to pick out the cotton from these fields early in the season and, owing to the limited area, the plants in these fields can be destroyed completely and at reasonable expense. Every field of cotton in the Red River Valley should be destroyed before November 10th of this year. If this is done, we feel safe in predicting that the planters will next year reap rich returns. On the other hand if the plants in these fields are allowed to stand until late, *furnishing weevils, and food for them, right up to the time of entering hibernation,* severe weevil damage in the Red River Valley may be again expected next year. The cotton planters in the Red River Valley now have an opportunity to insure for next year the largest cotton crop since the coming of the weevil. Complete and total destruction of all growing cotton in the Valley, as early as possible this fall, will insure it.

FALL DESTRUCTION OF COTTON PLANTS AND THE USE OF POISON.

Experiments made the past spring, and already described in our Circular No. 23, showed that applications of powdered arsenate of lead to the cotton plants just before the first squares appeared could be depended upon to remove practically all weevils from the field for the time being. The same experiments also demonstrated that the use of poison when the over-wintered weevils are *excessively* abundant cannot possibly be profitable.*

The same data also showed that the use of the powdered arsenate of lead will be proportionately more profitable in those cases where the over-wintered weevils are comparatively few in numbers. In other words, the fewer weevils there are to *be* killed in spring, the smaller will be the percentage surviving the poisoning operations to infest the crop. A reduction of the number of weevils in autumn, by the early and complete destruction of the cotton plants is a *necessary precedent to the successful use of poison* (powdered arsenate of lead) *the following spring.*

ARGUMENTS AGAINST FALL DESTRUCTION OF THE COTTON PLANTS.

The argument is repeatedly advanced that the crop cannot be picked out, owing to scarcity of labor or lateness in opening, early enough so that the plants can be destroyed by the planter at the time recommended. We realize the difficulties frequently in the way of properly putting this plan into execution. At the same time, in every section thoroughly infested by boll weevils, no top crop of any importance can be expected and the bulk of cotton produced is open and ready to pick by October 25th or November 10th at the latest. It is only a question of harvesting the cotton crop with the same rapidity and dispatch with which other crops are harvested. Even if some unopened bolls do remain in the fields at the time of destroying the plants, it is far better to destroy them along with the plants than to endanger the following year's crop for the sake of a few additional pounds of lint. It does not require an expert mathematician to see that it is more profitable to sacrifice 50 or 100 pounds of seed cotton per acre when destroying the weevils in autumn, *than to sacrifice from one-third to one-half a bale* of the following year's crop *by incubating weevils in the green cotton* plants *until winter and sending them* all, young and old, *into winter quarters, "fat and well fed."*

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* Circular 23, pages 27 to 31, inclusive.

In spite of all the arguments that may be brought to bear against this fall destruction of the cotton plants, the fact remains that in many localities in Louisiana the farmers will have to adopt it or abandon cotton growing entirely, as has already been done in parts of Texas where the summer rainfall is practically as great as in Louisiana. On the other hand, the uniform *early* fall destruction of the cotton plants will insure a good crop the following year and, when supplemented by the use of early maturing varieties, thorough preparation of soil, etc., it will afford as efficient a "remedy" for the boll weevil as is usually attained in the warfare against many other injurious insects which are not considered as threatening the prosperity of the country. With the improved varieties now being planted, and with the excellent methods of cultivation now in vogue, we conscientiously believe that early fall destruction of the cotton plants would result in better average crops of cotton now than were secured before the advent of the weevil.

Thousands of farmers have expended time and money in handpicking the weevils from the small cotton plants, in picking up infested squares, in the application of poisons and in the use of weevil-catching machines. The *same amount* of energy and money *devoted to the early fall destruction of the cotton plants* would *insure* a much *greater increase in the crop* and would at the same time render these other measures of less necessity.

METHODS OF DESTROYING THE COTTON PLANTS IN FALL.

On upland soils, where the cotton plants are small, it is frequently possible to plow them under. A chain can often be attached to the turning plow in such a way that the plants will be caught and thrown into the furrow ahead of the plow and be completely covered. We consider that plowing under the plants is as good as uprooting and burning them, provided that they are *completely* buried, with no tops, leaves or squares left in sight. Such plowing does not give satisfactory results when the ground is dry and lumpy, as spaces are left through which weevils, emerging from the squares and bolls, can escape.

The stalks can be cut down by running a sharp plow under them, severing the roots, after which they can be raked or piled together and then burned as soon as sufficiently dry. They should always be piled before they become dry enough for shedding of the leaves, as the latter assist materially in the burning after the piles of plants become dry.

Where cotton is tall and the plants large they can be removed in the above manner, or by pulling with a lever. The triangular stalk cutter, provided with a sharp knife upon each edge and which is drawn between the rows by a mule, severing the plants near the ground, can be used to advantage on rank cotton. However, the use of this instrument leaves stumps from one to three inches in height, and if the autumn weather be damp, these stumps put out sprouts which will furnish a food supply for such weevils as are not destroyed in the burning of the plants. Where the triangular stalk cutter is used, it must be followed by an immediate plowing of the field to destroy the stumps.

TIME TO DESTROY THE COTTON PLANTS.

The results of the killing frost of Nov. 13, 1907 (see page 43), would indicate that, one year with another, the complete destruction of the plants by November 10th to 12th would be followed with fairly good results. At the same time, the earlier the plants are destroyed, the fewer weevils there will be the following spring and the larger will be the succeeding year's crop. We would urge that the stalks be destroyed just as soon as the crop is picked out and at the same time we would urge that the *crop* be *picked* out as *early as possible.* Certainly the average planter can arrange to do this work by November 1st, or 10th, at the *very* latest. Where whole communities join in the work, the resulting good will be much more apparent but a lack of co-operation on the part of neighbors should not deter the individual planter from destroying his own cotton plants late in October or very early in November. The reduction in weevils on the one farm will far more than pay for the expense involved, even though surrounding farmers permit their plants to stand until winter. We know of individual farmers who have practiced the early fall destruction of stalks for the past three years, and so satisfactory have been their results that their neighbors have invariably "followed suit" the second or third year.

The effect of this fall destruction of the cotton plants upon the number of weevils surviving the winter is well illustrated by experiments made by Prof. W. D. Hunter at Dallas, Texas.*

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* Circular 95, Bureau of Entomology.

Large weevil-proof cages were constructed and cotton grown within them. In the fall of 1906 several thousand weevils were placed in each cage. At different dates, from October 13th on the cotton was removed from the cages, the weevils permitted to enter hibernation when they pleased, and the following spring the number of surviving weevils captured and counted. The following table shows the dates upon which cotton was removed from these cages and the number of weevils which successfully survived the winter in each case:

Date weevils were deprived of food (cotton plants).	Per cent. of weevils successfully surviving the winter of 1906-07.
Oct. 13, 1906	2.5%
Oct. 16, 1906	4.0%
Oct. 19, 1906	6.2%
Nov. 6, 1906	12.2%
Nov. 12, 1906	14.7%

This simply meant that on those farms where the cotton plants were permitted to stand in the field until Nov. 12th, or later, 14.7% of the weevils survived the winter to attack the next year's crop, and that on those farms where the plants were destroyed as early as Oct. 13, only 2.5% survived the winter. These conclusions are amply borne out in practice.

If, on account of scarcity of labor or for other reasons, picking *cannot* be completed by the dates mentioned above, by all means destroy the cotton plants as soon as the cotton *is* picked out, even if this operation is unfortunately delayed until as late as December. Experience and observation have shown that the good resulting from late destruction of the plants is sufficient to repay far more than the cost. Remember, that the *earlier* you destroy the plants this fall, the *larger* will be your next year's crop.

PICK OUT THE COTTON AT THE EARLIEST POSSIBLE MOMENT AND IMMEDIATELY THEREAFTER DESTROY ALL COTTON PLANTS!

GIVE A FAIR TRIAL TO THE ONE METHOD WHICH, ABOVE ALL OTHERS, IS THE MOST EFFICIENT AND PRACTICAL IN CONTROLLING THE BOLL WEEVIL.

Baton Rouge, La., August 24, 1908.

Approved: Chas. Schuler,
Active Chairman.

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State Crop Pest Commission
OF LOUISIANA.

CIRCULAR NO. 26. FEBRUARY, 1909.

The Circulars of the State Crop Pest Commission are sent free of charge to al farmers and fruit growers of Louisiana who make application therefor.

REPORT UPON VARIETY AND FERTILIZER EXPERIMENTS WITH COTTON IN THE BOLL WEEVIL INFESTED SECTIONS OF LOUISIANA.

BY WILMON NEWELL AND ARTHUR H. ROSENFELD.

After fall destruction of stalks, which is the most effective of all the steps which can be taken in combating the boll weevil, the rushing of the cotton crop to quick maturity comes next in importance. Indeed, the two are closely related and inter-dependent, for in order to get the maximum amount of benefit from destruction of the stalks they must be destroyed *early* (by October 25 or November 1), and to make this possible the cotton crop must be matured far in advance of what it was before the advent of the boll weevil.

For the making of an early crop, after early fall destruction of the cotton plants, three things are essential: (1) an early maturing variety of cotton, (2) early planting, and (3) frequent and shallow cultivations during the growing period. Which of the early maturing varieties is the best for each section of Louisiana can be determined only by experiments running through several years, as seasonal and soil conditions greatly affect the yields of all varieties.

The State Crop Pest Commission has for several years conducted variety tests with the most promising early maturing cottons, selecting localities for these experiments representing the typical soils of the various sections of the State. The results of these experiments are given below.

Another question of much importance to the cotton planter is

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that of how best to fertilize in order to increase the yield and hasten maturity of the crop, and probably no soils have given such widely varying results under the application of fertilizers as the alluvial lands of Louisiana. The Commission, during 1908, conducted two series of fertilizer experiments upon two types of Louisiana soils, the Red River bottoms of northwestern Louisiana and the prairie lands of the central portion of the State. At Bayou Pierre saturation of the soil by overflow water from Red River severely cut down the yield and at Mansura continuous rains from July 24 to August 5 caused heavy shedding of bolls already set and at the same time brought about a weevil infestation much heavier than normal. The yields in both experiments, while by no means large, are valuable in showing what can be accomplished under even the most trying conditions.

I. VARIETY TESTS.

Experiment At Bayou Pierre, 1908.

In this experiment the varieties Keno, Seago, Improved Peterkin, Mebane Triumph and Hawkins' Early Prolific were tested in comparison with cotton grown from native seed of the locality.*

The experiment was located on the plantation of Mr. J. G. Cunningham at Bayou Pierre, in Natchitoches Parish. The soil in the experimental plats was selected as being about an average of Red River cotton land. Alluvial, it contained a little sand, and was intermediate in physical condition between the light sandy soils left by overflows, and the stiff or ''buckshot'' lands. It had been in cultivation for many years and no fertilizer had ever been applied to it. The land was fairly level and quite well drained by means of ditches. All plats had been in cotton the previous year, and, owing to the abundance of weevils, the crop had been almost a total failure. The previous year's cotton plants had not been cut and burned until January, which practically amounted to not destroying them at all, so far as the weevil was concerned.

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*The Keno, Seago and Improved Peterkin seeds were secured from the Maxwell-Yerger Co., Mound, La. The Hawkins Early Prolific seed came direct from the originator, B. W. Hawkins, Nona, Ga. The Mebane Triumph was secured from the A. R. Roach plantation at Mansfield, La., where it had been used in the 1907 experiments, the seed having that year been purchased from the originator of the variety, A. D. Mebane of Lockhart, Texas. The "native" seed was secured at Bayou Pierre, but later in the season proved not to be the ordinary native cotton, but rather a mixture of several distinct varieties, with Hawkins evidently predominating.

PREPARATION AND CULTIVATION.

The land was plowed during the first week in January. On March 19 and 20 the ground was thoroughly and deeply disced, and the beds flushed with turning plows and made ready for planting. 200 pounds of high grade acid phosphate (containing 14% available phosphoric acid) per acre was applied March 26 to 28. The application was made in the drill with a one-horse Avery fertilizer distributer and the beds then closed by following the distributer with a "planker."

Planting was begun on March 30 and completed on April 1. All plats were harrowed before planting, V-shaped harrows being kept just ahead of the planters.

All plats were cultivated with a small-toothed harrow on April 20. On April 27 and 28 all plats were barred off, and the cotton chopped out, and on April 30 the plants were dirted up. From this time on, frequent shallow cultivations were given up to the time of laying-by, except during part of June and July, when the high water made work on the levee imperative, and the cultivation of the cotton was necessarily neglected. While the flood was at its height, the overflow water thoroughly saturated the ground in all plats.

INFESTATION, FRUITAGE, ETC.

On May 11 an examination showed that there were approximately 58 weevils per acre in the experimental plats. By May 28 the average number of over-wintered weevils in the cotton had increased to 155 per acre.

On June 13 an examination of squares was made by Mr. Geo. A. Runner, Assistant Entomologist, to determine the percentage of infestation. In the experimental plats 2% of the squares were found infested and in other fields close to timber this percentage was found to range from 3½% to 12%.

Blooms appeared first in the Triumph and "native" plats.

On July 9 an examination of the plats was made by Mr. Runner, to determine the comparative fruitage of the different varieties. By counting the number of bolls on many plants in each plat, the average number of bolls per plant was ascertained.

These averages were as follows: Hawkins' Early Prolific, 17.8 bolls per plant; Improved Peterkin, 15.8; Mebane Triumph, 12.4; Seago, 11.4; Keno, 10.9 and "native," 10.9.

On this same date the plats showed an average infestation of squares of 11⅛%, and of bolls, 4⅛%.

PRODUCTION.

The plats were surveyed on September 9, by Mr. J. C. Henry, Civil Engineer, of Natchitoches, La., and the acreage determined.

The weights of the cotton, as picked, were kept by the owner of the plantation. The production was found to be as given below:

PRODUCTION, VARIETY TESTS, BAYOU PIERRE EXPERIMENT.

Plat No.	Variety	Yield per acre, 1st picking, (Aug. 19—29), lbs. seed cotton.	Total yield per acre, lbs. seed cotton.
9	Keno	743.	1031.
6	Hawkins Early Prolific	702.	911.
5	"Native"	600.	791.
8	Seago	599.	773.
7	Improved Peterkin	486.	749.
4	Mebane Triumph	486.	744.

QUALITY OF COTTON PRODUCED.

Mr. Geo. A. Poleman, of Shreveport, La., kindly consented to class the lint of the various varieties. Each sample sent Mr. Poleman was made up by collecting one lock from each of many plants in different parts of each plat. The samples were numbered, and Mr. Poleman was not advised as to the varieties he was grading. The following table gives Mr. Poleman's classification:

STAPLE, GRADE AND VALUE, DIFFERENT VARIETIES.

Variety	Length of staple.	Grade	Value (nominal on basis of 10 cents per lb. for middling.)
Keno	1¼ in.	Mid.	4c. on
Hawkins Early Prolific	¾ in.	Mid.	
"Native"	1-1-16 in.	Mid	¼c. on
Seago	1-¼ in.	Mid.	4c. on
Improved Peterkin	1 in.	St. Mid.	
Mebane Triumph	1-1-16 in.	Good Mid.	¼c. on

The production of Keno cotton was rather surprising, as this had not been considered a particularly early maturing variety. Further experiments should be made before the value of this variety for the weevil section is decided upon.

As will be noticed, Mebane Triumph gave a comparatively low yield in this experiment. On account of its heavy foliage this variety is not regarded as one of the best for the alluvial lands, but in previous seasons it gave much better results than in this experiment. This is probably due, in part at least, to the excessive wet weather of 1908 causing a larger amount of shedding and rotting than usual in the heavier foliage cottons.

Variety Test at Mansura, 1908.

In this experiment comparative test was made of Mebane Triumph, Hawkins' Early Prolific, King, Rowden, Simpkins', Toole's Early Prolific, and native cotton.*

This experiment was conducted on the farm of Mr. Edward A. Coco, just east of Mansura, in Avoyelles Parish. It was similar in most respects to the one at Bayou Pierre except that the type of soil was different, and different varieties were tested. All plats were upon well-drained land, comparatively level and even

*The Mebane Triumph, King and Rowden seeds were secured from Mr. A. R. Roach of Mansfield, La. The Simpkins was purchased of Hon. William Polk, Alexandria, La., and the Hawkins Early Prolific from Mr. H. M. Gandy of Negreet, La. The seed of Toole's Early Prolific was kindly donated for the experiment by Mr. West Livaudais of New Orleans, who secured the seed direct from North Carolina. The native seed was secured from a farmer at Mansura.

in composition, as indicated by the growth of the previous year's stalks, which were still standing on February 27, when the plats were laid out.*

The soil was what might be termed a "chocolate loam," dark, rather sandy, and reasonably light. It was quite typical of the soils in this section of the State that are not subject to overflow. To the east of the experimental field was a large area of swamp land, and hibernating quarters for the weevils were excellent in the surroundings of these plats. So far as known, no fertilizer of any kind had ever been applied to this land. It had been in cultivation many years.

PREPARATION AND CULTIVATION.

Plowing was commenced on March 12, and finished March 16. Three hundred pounds acid phosphate (14% available) per acre was applied by means of an Avery distributer, on March 26, and all plats were planted on April 2, a harrow being run over the beds just prior to planting. Practically the same cultivation was given as at Bayou Pierre, except that there were no interruptions by overflow, as at the former place.

A satisfactory stand was at first obtained, but unfavorable weather, cotton lice, and "sore shin" so injured this later on that replanting had to be done.

INFESTATION, FRUITAGE, ETC.

Two adult boll weevils were found while planting on April 1, indicating that an early emergence had taken place. On April 23 an average of 23 weevils per acre was found in the experimental plats. By May 25 the number of over-wintered weevils per acre had increased to 109 and by June 2 this number had increased to 283 per acre.

The first blooms appeared in the Toole's Early Prolific

On June 2, 6% of the squares were found to be infested by the weevils.

On July 18 the average fruitage of individual plants in each variety was determined by counting the bolls on a large number of average-sized plants. This fruitage was found to be as follows: Toole's Early Prolific, 11.6 bolls per plant; Hawkins' Early Prolific, 10.8; Rowden, 8.2; King, 8.1; Simpkins', 8.1; Triumph, 6.5, and native, 6.5.

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*This failure to have the stalks destroyed the previous fall of course subjected the experimental plats to a very great handicap from the beginning. The plats were also placed under a great additional handicap by the rains of July and August, which, according to Mr. Coco, began on July 24 and continued almost without interruption until August 5.

On this same date a careful count and examination of squares showed that 54% of the squares and 2% of the bolls were infested by the weevils.

The first open boll was found in the Toole's Early Prolific on July 18.

PRODUCTION.

All plats were surveyed on September 23, 1908, by Mr. W. R. Messick, Parish Surveyor of Avoyelles Parish. Mr. Coco kept the weights of seed cotton as picked. The production of the several varieties is given in the table on the following page.

TABLE.

PRODUCTION OF VARIETIES,

MANSURA EXPERIMENT,

1908.

Variety.	1st Picking.		2nd Picking.		3rd Picking		4th Picking.		TOTAL, Lbs. Seed Cotton per acre.
	Date of	Lbs. Seed Cotton per acre	Date of	Lbs. Seed Cotton per acre	Date of	Lbs. Seed Cotton per acre	Date of	Lbs. Seed Cotton per acre	
Hawkins' Early Prolific.........	Sept. 1-12	212	Sept. 13-19	168	Oct. 5-7	92	Oct. 14	91	563
Toole's Early Prolific.........	Aug. 25-29	165	Sept. 25 Oct. 5	237	Oct. 17	51			453
Rowden..........	Sept. 1-5	42	Sept. 6-10	99	Sept. 11-19	132	Oct. 3-8	109	382
Simpkins.........	Sept. 1-5	108	Sept. 6-17	89	Oct. 2-8	94	Oct. 14	47	338
Mebane Triumph.	Sept. 1-5	189	Sept. 26 Oct. 5	114					303
King.............	Sept. 1-5	88	Sept. 20 Oct. 3	126					214
Native...........	Sept. 1-5	27	Sept. 6-13	69	Sept. 21 Oct. 5	65			161

As in the Bayou Pierre Experiment also, a sample of each variety were submitted to Mr. Geo. A. Poleman, of Shreveport, who classed them as follows:

STAPLE, GRADE AND VALUE, DIFFERENT VARIETIES.

Variety	Length of Staple.	Grade.	Value (nominal on basis of 10c. per lb. for middling.)
Hawkins' Early Prolific........	1 in.	Mid.	
Rowden	1 in.	St. Mid.	
Simpkins	¾ in.	Mid.	
Mebane Triumph..	1-1-16 in.	Mid.	¼c. on.
King.................	1 in.	St. Mid.	
Native	1 in.	Mid.	

Other Variety Tests.

In 1906, the State Crop Pest Commission conducted experiments at two typical localities in the State, using Mebane Triumph, King and southern Missouri* seed in comparison with the ordinary native seed of each place. One of these experiments was located on the farm of Mr. D. J. Bland, at Logansport, De Soto Parish, on typical hill land.

The other experiment was made by Mr. Jas. E. Byram, at Batchelor, Pointe Coupee Parish, on typical alluvial Mississippi Valley soil. The detailed results of these experiments were published in Circular No. 11 of the Crop Pest Commission, but as this Circular has long since been exhausted it is thought best to give here the production of the different varieties. Boll weevils were excessively abundant at Logansport, but the infestation had not at that time reached Batchelor, hence the comparatively large yields in the latter experiment. The following table shows the yield in both experiments:

*It should be made clear here that "southern Missouri" is not a variety of cotton. When seed from the northern portion of the cotton belt is brought to the southern portion and there planted, the resulting crop matures much earlier than the average native cotton. If seed from this first crop be again planted, the resulting crop, viz., second crop, will be later than the first. In the case of "northern grown" seed, therefore, new seed should be obtained from the northern part of the cotton belt at least every two years, as such cotton does not retain indefinitely its character of earliness, like true varieties, such as King, Triumph, Toole's or Rowden.

YIELD, DIFFERENT VARIETIES, LOGANSPORT AND BATCHELOR EXPERIMENTS, 1906.

VARIETY	Yield, lbs. Seed Cotton per Acre.	
	Logansport Experiment.	Batchelor Experiment
Mebane Triumph...	1155	1609
King..................	1027	1850
South Missouri......	1006	2102
Native.................	948	1570

No fertilizer was used in either of the above experiments.

In an experiment on Mr. J. A. Mayeux's farm at Marksville, Avoyelles Parish, on the typical prairie soil of that section, the following amounts of seed cotton were secured:

	Pounds Per Acre.
Toole's Early Prolific....................	1,807
Mebane Triumph..........................	1,798
Native	1,625
Northern Oklahoma*....................	893

At Mansfield, De Soto Parish, in 1907, the following comparative yields were obtained in a test of Toole's Early Prolific and Mebane Triumph.

	Pounds Seed Cotton Per Acre.
Toole's Early Prolific.....................	943
Mebane Triumph..........................	892

In an experiment made on Mr. Xavier Nick's place, at Marksville, La., in 1908, on prairie soil, a comparison of Simpkins' and Mortgage Lifter cottons gave the following:

	Pounds Seed Cotton Per Acre.
Simpkins'	883
Mortgage Lifter.............	666

This is a very good showing for Simpkins' cotton, as the cotton plants on the farm were not destroyed the previous fall, and the infestation in the spring was very heavy. It may be remarked here that Mortgage Lifter is too late a variety to be safely grown in a boll weevil section.

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*The same remarks apply to this cotton as to South Missouri. (See footnote on page 73.)

On Mr. Frank Laborde's place, at Marksville, under even worse conditions as to hibernation of weevils than at Mr. Nick's place, an average of 544 pounds seed cotton per acre was obtained in two experimental plats of the Simpkins variety.

Mr. C. E. Keithly, of Wolfe City, Texas, has kindly reported to us the following results:

	Pounds Lint Per Acre.
Cook's Improved	400
King's Improved	300

A neighbor of Mr. Keithly's got the following results:

Cook's Improved	1 bale per acre.	(6 acres).
Rowden	3/4 bale per acre.	(6 acres).

Mr. H. M. Gandy, of Negreet, Sabine Parish, in a letter to the Commission, dated January 30, 1908, reports that with Hawkins' Early Prolific cotton, he secured on 23 acres worked by himself, an average of 1,328 pounds of seed cotton per acre, while his renters, on 18 acres, produced 1,195 pounds seed cotton per acre.

PERCENTAGE OF LINT PRODUCED BY VARIOUS VARIETIES.

Mr. A. R. Roach, of Mansfield, La., reports the following percentages of lint secured from four varieties in 1908, determined by actual weight of seed cotton, and net weight of lint secured from it:

Mebane Triumph	39-1/2%
Toole's Early Prolific	33-4/5%
Rowden	33%
King's Improved	32-1/3%

II. FERTILIZER EXPERIMENTS.

Bayou Pierre Fertilizer Experiment, 1908.

In this experiment Mebane Triumph cotton was used in all plats. The experiment was located on the plantation of Mr. J. G. Cunningham, and the preparation, planting, cultivation, etc., of the plats was the same as was given the variety tests on the same plantation, except as hereinafter mentioned.

The following is an outline of the experiment:

Plat 10.—Fertilized with acid phosphate, 200 pounds per acre, applied a few days before planting.

Plat 11.—No fertilizer.

Plat 12.—Fertilized with acid phosphate, 600 pounds per acre, applied a few days prior to planting.

Plat 13.—Forty pounds nitrate of soda per acre, applied just after coming up of cotton.

Plat 14.—Acid phosphate, 200 pounds per acre, applied a few days prior to planting, and 40 pounds nitrate of soda per acre, applied just after coming up of cotton.

Plat 15.—Acid phosphate, 200 pounds per acre, applied a few days prior to planting, and a second application of acid phosphate, 100 pounds per acre, in June.

Plat 16.—Acid phosphate, 200 pounds per acre, applied a few days prior to planting; 40 pounds nitrate of soda per acre, applied just after coming up of cotton, and a second application of acid phosphate, 100 pounds per acre, in June.

On March 27 the first application of acid phosphate was made, 200 pounds per acre in Plats 10, 14, 15 and 16 and 600 pounds per acre in Plat 12. The fertilizer was applied by means of an Avery distributer, all lumps of phosphate being finely pulverized to prevent clogging the distributers and to insure an even distribution of the phosphate.

On April 9, as the cotton was just coming up, 40 pounds of nitrate of soda per acre was applied to Plats 13, 14 and 16, the nitrate being finely pulverized and mixed with five times its bulk of sand.* It was applied by scattering it along the rows and allowing it to fall directly on the young plants.**

As the season progressed an increased growth on all plats where nitrate of soda had been applied, could be plainly seen.

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*Two hundred pounds of the nitrate of soda used in the above experiment were kindly donated by Mr. Wm. S. Myers, president of the Nitrate of Soda Propaganda, New York. The balance of the nitrate was purchased. The acid phosphate used in all the fertilizer experiments was guaranteed 14 per cent available, and analyzed about 15 per cent phosphoric acid actually available.

**It may be of interest here to give the expense incurred in applying this nitrate. Six hands were employed for one-third of a day, the total cost of labor being $1.50, or about 17 cents per acre for the nine acres.

INFESTATION, FRUITAGE, ETC.

On July 9, the average number of bolls per plant was determined, and found to be as follows in the various plats:

	Bolls.
Plat 10	11.46
Plat 11	9.70
Plat 12	14.68
Plat 13	9.74
Plat 14	15.10
Plat 15	16.94
Plat 16	18.86

On the same day, the percentage of square and boll infestation in the plats was found to be about the same as in the variety plats (see page 67).

PRODUCTION.

The fertilizer plats were surveyed by Mr. J. C. Henry at the same time that he surveyed the variety plats, and the acreage determined. As in the latter experiment, record of the cotton picked was kept by Mr. Cunningham.

PRODUCTION OF MEBANE TRIUMPH COTTON, FERTILIZED IN DIFFERENT WAYS, BAYOU PIERRE, 1908.

Plat No	Description, and Amount of Fertilizer per Acre.	Yield per acre.	
		1st Picking	Total Yield
10.	200 lbs. acid phosphate before planting	451	764
11.	CHECK (no fertilizer)	396	719
12.	600 lbs. acid phosphate before planting	415	683
13.	40 lbs. nitrate of soda as cotton came up	480	792
14.	200 lbs. acid phosphate before planting, 40 lbs. nitrate of soda when cotton came up	716	1042
15.	200 lbs. acid phosphate before planting. 100 lbs. more in June	747	927
16.	200 lbs. acid phosphate before planting, 40 lbs. nitrate of soda as cotton came up and 100 lbs. acid phosphate in June	796	1019

As usually happens when fertilizers are used for cotton on rich alluvial soils the results proved very variable and about the only conclusion that can be consistently drawn from the foregoing figures is that the nitrate of soda increased the production wherever used. Thus Plat 13, with 40 pounds per acre of the nitrate, produced 73 pounds more (seed cotton) per acre than Plat 11, to which no fertilizer was applied. Plat 14, with 200 pounds acid phosphate and 40 pounds nitrate, produced 278 pounds more than Plat 10, which received the 200 pounds of phosphate only. Plat 16, with two applications of phosphate amounting to 300 pounds per acre and 40 pounds of nitrate, produced 92 pounds more than Plat 15, which received the same applications of phosphate, but no nitrate. In all these cases the extra cotton produced more than paid for the nitrate and the labor of applying it. This latter item was approximately as follows:

40 pounds nitrate at 3 cents....................	$1.20
Labor cost of application (see footnote on page 76)	.17
Cost per acre................................	$1.37

The soil on which this experiment was made undoubtedly contained all the nitrogen needed by the cotton plant and we are therefore inclined to believe that the increased production resulting from the nitrate of soda applications was due entirely to the large supply of nitrogen, while the plants were small and tender, keeping the plants growing steadily during cold spring weather and enabling them to overcome the attacks of cotton lice. It is very likely that all of this nitrate was leached out of the soil before the bolls reached maturity. These results suggest that individual planters test top-dressings of nitrate upon a small scale, even on rich lands. (See also records of the Mansura experiment, page 82.)

Mr. Poleman graded the cotton taken from the different plats, as follows:

STAPLE, GRADE AND VALUE OF MEBANE TRIUMPH FERTILIZED IN DIFFERENT WAYS, BAYOU PIERRE, 1908.

Plat.	Length of Staple.	Grade.	Value (nominal on basis of 10 cents per lb. for middling).
10.	1 in.	St. Mid.	
11.	1 in.	St. Mid.	
12.	1 in.	Mid.	
13.	1--1-16 in.	St. Mid.	¼c. on.
14.	1--1-16 in.	St. Mid.	¼c. on.
15.	1--1-16 in.	Mid.	¼c. on.
16.	1--1-16 in.		¼c. on.

Mansura Fertilizer Experiment, 1908.

This experiment was conducted on the plantation of Mr. Edward A. Coco, the same place upon which the variety tests at Mansura were conducted. The preparation of the soil, planting, cultivation, infestation, etc., was practically the same for these plats as for the variety test, except as hereinafter stated. The experiment was conducted along exactly the same lines as the Bayou Pierre fertilizer experiment just described, except that 300 pounds of acid phosphate were used to the acre in this experiment, against 200 pounds used in the Bayou Pierre plats and 45 pounds nitrate of soda against 40 pounds at Bayou Pierre. All of these plats were planted to Mebane Triumph.

Acid phosphate was applied to the plats upon which it was used on March 27, an Avery guano distributer being used for the application. On April 11, 45 pounds per acre of nitrate of soda were applied to the proper plats, the nitrate being applied in the same manner as at Bayou Pierre. The actual cost of applying the nitrate was found to be 16 cents per acre in this case.

As in the Bayou Pierre experiments, a marked increase in growth could be noted, as the season progressed, in the plats upon which nitrate of soda was used. It was noted that the nitrate seemed to enable the plants to withstand a heavy attack of cotton lice, from which the other plats all suffered.

INFESTATION, FRUITAGE, ETC.

On July 17, the average number of bolls per plant in each plat was found to be as follows:

Plat.	Description.	Average Number Bolls per Plant.
31.	300 lbs. acid phosphate before pltg...	6.82
32.	NO FERTILIZER..................	4.22
33.	600 lbs. acid phosphate before pltg..	8.14
34.	45 lbs. nitrate of soda as cotton came up..................................	4.52
35.	300 lbs. acid phosphate before pltg. 45 lbs. nitrate of soda as cotton came up...:......................	8.92
36.	300 lbs. acid phosphate before pltg. 100 lbs. more in June............	9.38
37.	300 lbs. acid phosphate before pltg. 45 lbs. nitrate of soda as cotton came up, 100 lbs. acid phosphate in June..........................	10.90

On the same date an extended examination of the plats showed that 70% of the squares and 2½% of the bolls were weevil-infested.

PRODUCTION.

Each plat was surveyed by Mr. W. R. Messick and, as in the variety experiments, all weights of cotton picked were kept by the owner of the farm, Mr. Edward A. Coco. The production of the different plats is given in the table on the following page.

TABLE.

PRODUCTION OF MEBANE TRIUMPH COTTON,

FERTILIZED IN DIFFERENT WAYS,

MANSURA, 1908.

Plat No.	1st Picking		2nd Picking.		3rd Picking.		4th Picking.		TOTAL, Lbs. Seed Cotton Per Acre.
	Date of	Lbs. Seed Cotton Per Acre	Date of	Lbs. Seed Cotton Per Acre	Date of	Lbs. Seed Cotton Per Acre	Date of	Lbs. Seed Cotton Per Acre	
31	Aug. 25 Sept. 4	139	Sept. 4-8	27	Sept. 10-16	213	Oct. 2-7	51	430
32	Aug. 18-20	30	Aug. 23-28	73	Sept. 4-10	84	Oct. 2-9	26	213
33	Aug. 25-29	138	Sept. 1-5	95	Sept. 10-15	130	Oct. 5-10	76	439
34	Aug. 18-20	33	Aug. 21 Sept. 4	12	Oct. 3	107	Oct. 7-10	78	230
35	Aug. 18-20	41	Sept. 1-10	63	Sept. 12-18	201	Oct. 7-10	81	386
36	Aug. 20-24	91	Aug. 26 Sept. 4	167	Sept. 5-12	28	Oct. 3-5	56	342
37	Aug. 17-18	74	Aug. 25 Sept. 10	68	Sept. 15-25	147	Oct. 2-8	104	393

It will be noted from the above table that the increase in production following the application of nitrate of soda was not as pronounced as in the Bayou Pierre experiment (see page 77). In two cases (by comparing Plat 37 with Plat 36 and Plat 34 with Plat 32) a slight increase in production followed the use of nitrate, but in another case (comparing Plat 35 with Plat 31) there was an actual decrease.

It was self-evident also that the excessive weevil infestation, brought about by the wet weather, prevented the plants from utilizing more than a small part of the fertilizer. To this, more than anything else, we ascribe the failure of the heavily fertilized plats to make proportionately more cotton than those lightly fertilized.

The following is Mr. Poleman's classification of the cotton from each of the plats:

STAPLE, GRADE AND VALUE OF MEBANE TRIUMPH FERTILIZED IN DIFFERENT WAYS, MANSURA, 1908.

From Plat No.	Length of Staple.	Grade.	Value (nominal on basis of 10 cents per lb. for middling).
31.	1 in.	St. Mid.	
32.	1-⅛ in.	Good Mid.	1-¼c on.
33.	1 in.	Mid.	
34.	1 in.	Mid.	
35.	1--1-16 in.	St. Mid.	¼c on.
36.	1-⅛ in.	St. Mid.	1-¼c on.
37.	1--1-16 in.	St. Mid.	¼c on.

Other Fertilizer Experiments.

The following table shows a comparison of fertilized and unfertilized cotton at Logansport, La., in 1906, on the farm of Mr. D. J. Bland. The fertilizer used was 200 pounds per acre of "11-2-0" fertilizer, made by mixing 200 pounds 15% acid phosphate with 100 pounds cotton seed meal.

PRODUCTION OF FERTILIZED AND NON-FERTILIZED COTTON, LOGANSPORT, 1906.

Variety.	Yield in Pounds Seed Cotton Per Acre.			
	Non-Fertilized.	Fertilized.	Gain.	Loss.
Mebane Triumph..	1155	1382	227	
Southern Missouri	1006	1508	502	
Native	948	1194	246	
King	1027	1021		6

The following table, taken from page 14 of Circular 11 of the State Crop Pest Commission, shows the yields at Batchelor in 1906, where different fertilizers were used, as compared to unfertilized cotton. This experiment was on alluvial Mississippi valley land, and there were no boll weevils in Pointe Coupee Parish at the time this experiment was made. The yield is given in pounds seed cotton per acre:

Variety.	Unfertilized.	Fertilized with 300 lbs. "11-2-0" per acre.	Fertilized with 300 lbs. acid phosphate per acre.	Fertilized with 300 lbs. "10-0-4"* per acre.
Native	1570 lbs.	1596 lbs.	1324 lbs.	1298 lbs.
Southern Missouri	2102 "	1544 "	1586 "	1623 "
Mebane Triumph..	1609 "	2217 "	1524 "	1732 "
King	1850 "	1638 "	1305 "	1798 "

Mr. P. P. Keith, Jr., of Keithville, Caddo Parish, reports that on sandy upland soil in 1908, using Mebane Triumph cotton, he made 1,185 pounds of seed cotton per acre on unfertilized land, and 1,568 pounds per acre where he fertilized with 100 pounds of nitrate of soda per acre.

III. THE QUESTION OF LATE PLANTING TO AVOID WEEVIL INJURY.

From time to time during the past twelve years the idea has been advanced that if all cotton were planted late, the overwintering weevils would starve to death before finding squares in which to breed in the spring. The obstacles in the way of such a plan succeeding may be briefly summarized as follows:

---

*Contained 10 per cent available phosphoric acid and 4 per cent potash. This was made by mixing 200 pounds of acid phosphate (15 per cent available) with 100 pounds of kainit.

1. All of the boll weevils do not come out of their winter quarters at any one time in the spring, or even during any one week or month. At Keachie, La., in the fall of 1905, the State Crop Pest Commission built large cages, 10 feet by 16 feet and 8 feet high, covered with wire-cloth and thoroughly "weevil-proof." In each cage was placed a pile of leaves, trash, stumps, moss, grass, etc., to afford weevils just such protection as they get out-of-doors during the winter. Adult weevils were gathered in the cotton fields and from 1,000 to 4,000 (all carefully counted) placed in each cage. The following spring these cages were examined twice a day from March 5 to July 5 and as fast as weevils came out of the trash they were removed from the cages and counted. The first weevil came out of the trash on March 22 and the last one on June 28. Following is the rate at which they came out of their winter quarters: Of the total number *which survived the winter,* 5% came out before March 31, 24% came out between April 1 and 15, 19% between April 16 and 30, 20% between May 1 and 15, 25% between May 16 and 31, and 6% between June 1 and 15. From this it is seen that *over 30% of the surviving weevils remained in winter quarters until after May 15.*

2. The average life of boll weevils, after they come out of their winter quarters in spring, is from six to eight weeks. It is true that many of the weaker ones live but a few days and of those which come out extremely early, many die before the plants begin to square, but others live for many weeks, which makes the average life, after leaving hibernation, as above. In our own experiments we have known weevils to live from November until the following July. Prof. W. D. Hunter, at Dallas, Texas, has had them live from November until the following October, a period of eleven months.

3. During the cool weather of May and early June, from 27 to 30 days are required for a generation of weevils to mature. In the hot weather of July a generation of weevils can be produced in 14, or even in 12 days.

4. Cotton planted early is squaring very rapidly by July 1, the time when the weevils breed rapidly, and it has a chance to produce squares faster than the weevils can destroy them.

5. Cotton planted late is squaring very slowly by July 1, when the weevils are increasing most rapidly. It must be self-evident that early-planted cotton contending with a large number of slowly increasing weevils, has a far better chance than late-planted cotton squaring slowly in the presence of *weevils increasing rapidly.*

6. A majority of the most experienced cotton planters in Louisiana express the opinion that, except in rare instances, only from one-half to three-fourths of a crop can be made if planting be deferred until May 15 or June 1, even *with no boll weevils present.* If this be true, it is inconceivable that such late-planted cotton would produce a crop *with boll weevils present.*

7. Cotton seed dropped along ditches, around gin houses, in fields and scattered along bayous, sends up volunteer cotton plants early every spring and these volunteer plants would furnish food (and perhaps breeding squares also) for the weevils, even if all planters deferred planting of the main crop until late.

There is the additional consideration that if late planting offered any advantages in the warfare against the weevil, some of the thousands of Texas farmers would have found it out long ago (as when they replanted after late frost or overflow) and would be practicing it. As a matter of fact, every successful Texas farmer plants early.

Late Planting Experiments At Leesville and Merryville.

In 1906 the Crop Pest Commission made two experiments in late planting, one at Merryville, Calcasieu Parish, and the other at Leesville, Vernon Parish. The results of these experiments were published in detail in Bulletin 92 of the Louisiana State Experiment Stations, but as this bulletin has long since been out of print, a brief summary of the experiments is here given.

Both experiments were located on farms isolated from other cotton, the Vernon Parish experiment being 2½ miles away from the nearest cotton, and 10 miles from any considerable amount, while there were probably not more than 30 acres of cotton grown within a radius of 5 miles of Merryville. Both fields were thoroughly prepared during the latter part of May and fertilized with 300 pounds per acre of "8-2-2" fertilizer, and both were planted on June 5 and 6. Boll weevils made their appearance as soon as the plants commenced to square in both experiments, and the infestation soon became general.

The Leesville experiment produced but 266 pounds of seed cotton per acre, against about 1,200 pounds the year previous, when cotton was planted early *and not fertilized,* and this despite the fact that seasonal conditions in 1906 were particularly favorable for a high yield.

The field at Merryville produced 547 pounds seed cotton per acre, while in previous seasons, without fertilization, it had averaged from 750 to 1,000 pounds per acre.*

In rare instances fields in highly favored situations do produce a fair crop when planted to an early variety in the latter part of April or during early May, but as a general rule late-planted cotton is almost totally destroyed by the boll weevils.

Approved:

CHAS. SCHULER, Active Chairman.

Baton Rouge, La., February 10, 1909.

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*The following interesting account of similar experiments in late planting, made in Texas by Prof. W. D. Hunter, is taken from the Yearbook of the U. S. Dept. of Agriculture for 1906, page 323:

"For these experiments fields were selected which were completely isolated from other cotton to prevent the inflow of weevils from other fields. In not one of the four cases was any cotton whatever produced. The plants grew well, in some places reaching a uniform height of five feet, and the only apparent factor in preventing the maturing of a crop of cotton was the presence of the weevil. The most striking of the four experiments was located on the Edwards Plateau, about thirty miles west of Kerrville, Texas. At this place was found a field of sixteen acres, which had been in cotton in 1905. Very early in November of that year the owner turned a large herd of goats into the cotton field during a drought which had reduced his pasturage area. In a few days no traces of green portions of the plants were visible. The goats stripped the stalks of leaves, squares and bolls. Cold weather followed during November, preventing the growth of any sprouts from the stalks which might have furnished sustenance for the weevils. No other cotton was planted nearer than nine miles from this field either in 1905 or 1906. During 1906 the field was planted on June 10. The cotton grew to a height of about five feet, but weevils appeared practically as soon as the plants came up and soon multiplied sufficiently to cut off all the fruit. There is no reason to suppose that the weevils that did this damage were not those which passed the winter in the immediate vicinity. The appearance of the first specimens found clearly indicated that they were hibernated individuals. Their numbers and the time of their appearance, together with a considerable amount of data now available as to the distance hibernated weevils can fly, show clearly that they had survived the long period from November to July without food."

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CIRCULAR NO. 27

OF THE

State Crop Pest Commission

OF

LOUISIANA

Some Common Insects Injurious to Truck Crops

By Wilmon Newell and Arthur H. Rosenfeld

ISSUED UNDER THE DIRECTION OF THE
STATE BOARD OF AGRICULTURE AND IMMIGRATION
CHAS. SCHULER, Commissioner.

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A colony of Argentine ants in its nest. Near the center of the group the large queen can be seen. The other ants are workers. See p. 112. (Senior author's illustration, from Journal of Economic Entomology.)

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State Crop Pest Commission
OF LOUISIANA

CIRCULAR No. 27. JULY, 1909.

The Circulars of the State Crop Pest Commission are sent free of charge to all farmers and fruit growers of Louisiana who make application therefor.

SOME COMMON INSECTS INJURIOUS TO TRUCK CROPS.

BY WILMON NEWELL AND ARTHUR H. ROSENFELD.

The rapid rate at which the trucking interests of Louisiana have developed during the past few years has been extremely gratifying. Not only have a number of sections, favored with good transportation and market facilities, inaugurated market gardening upon a large and successful scale, but throughout the State increased attention has been paid to the growing of vegetables for the local market and for home consumption. Doubtless the invasion by the boll weevil has been largely responsible for more attention being paid by farmers to the production on their own farms, of food stuffs which they require.

With this increase in truck growing, the trucker and farmer alike have found that various and divers insects are at hand to attack and destroy any garden crop they attempt to raise. The inquiries reaching the Crop Pest Commission for information about these various pests and means of controlling them have become so numerous that a brief circular on the subject is called for. It is no longer possible to give in personal letters all the detailed information now needed by the hundreds growing truck for market and the thousands growing vegetables for home use. To meet this need we have prepared the present circular. It does not present the results of special investigations or experiments. On the contrary it has been our aim to compile and "boil down" all of the most practical information regarding the most serious garden insects, so that it will be available for the use of the average farmer. We have not hesitated to draw freely from the published writings of various distinguished entomologists and from our correspondence with entomologists in other states. In this connection we wish to acknowledge our indebtedness particularly to Dr. L. O. Howard, Professors A. L. Quaintance and F. H. Chittenden, of the Bureau of Entomology, United

States Department of Agriculture, Dr. John B. Smith, State Entomologist of New Jersey, and Professor R. I. Smith, Entomologist of the North Carolina Experiment Station, for information drawn freely from their books and bulletins.

The Loss Caused by Garden Insects.

A leading authority of the United States Department of Agriculture[1] has estimated that the truck growers of the United States suffer an annual loss of over $53,000,000 as a result of the damage by insects to their crops. In Louisiana the truck growers pay perhaps a larger toll to injurious insects than in any other State of the Union. It would be interesting to discuss the reasons for this, but it will at present suffice to say that the semi-tropical climate and the introduction of many noxious insects from abroad are the most prominent reasons for this heavy loss.

Some Necessary Knowledge.

With the truck grower, as with the farmer and fruit grower, a knowledge of some essential facts regarding practical entomology is necessary if he would keep insect loss reduced to a minimum. Before an insect can be fought successfully certain features concerning its anatomy, life history and habits must be known. The more complete our knowledge of these things the more chance we have of finding a weak point in the insect's development where it can be successfully attacked. For example, it is very important that the truck grower should understand the difference between sucking insects and biting insects, and he should be able to distinguish the one kind from the other by a casual examination of them. Sucking insects are those which have their mouth parts developed into long beaks, or piercing organs, which are thrust through the epidermis of the plant to the interior and the sap sucked up through them. Insects of this kind cannot be poisoned with arsenical poisons, such as Paris green, for the poison can be applied only to the exterior surface of the plant, while the insect derives its food entirely from the interior of the plant. Plant lice and scale insects are good examples of this class.

Biting insects, on the other hand, feed upon plants by actually chewing up the epidermis and other portions. The various caterpillars and so-called "worms" which feed upon fruit trees and garden crops will serve as illustrations of biting insects. As a general thing insects of this kind are easily controlled, for if some arsenical, such as Paris green or arsenate of lead, be applied to the plants the insects will eat it along with their food and be killed.

---

[1] C. L Marlatt, Year Book, U. S. D. A., 1904, p. 464.

That an insect's life history must be well known before remedial measures can be devised to good advantage is so true that it is almost axiomatic. In the development of almost every insect there is a time when the insect is either unprotected or presents an opportunity for the truck grower to deal it a severe blow. It is by careful scientific studies to determine these weak points in the life histories of various insects that the entomologist does his most important work. Our common army worm illustrates this point exactly. The winter is passed by the army worm in the pupal or chrysalis stage, just below the surface of the earth. By plowing during the winter and exposing the cocoons to the weather and to the attacks of birds and animals the numbers of the army worm can be greatly reduced. The burning over of hedgerows and ditches also roasts a number of pupae which are near the surface. However, no one thought of taking these simple steps until it was discovered just how the army worm passed the winter. In other cases the weak point in an insect's life may be found in the egg, larval or adult stage, or it may be found in the manner in which the insect hibernates during the winter months.

Remedial measures must always be devised to fit the insect. No one insecticide or single method of fighting insects can be used successfully against all of our insect enemies any more than a physician can use one kind of medicine for all cases of human illness. Out of the many insect enemies which are of importance to the truck growing industry, the following appear to be of most importance in Louisiana:

THE IMPORTED CABBAGE-WORM.

(*Pontia rapae* Sch.)

This insect, like many other serious pests, is not a native of this country, but was many years ago accidentally imported from Europe. It has now spread over most of the United States and Canada. The adult insect is a white butterfly, and is very common around the garden during the summer and autumn. It can be recognized at once from the illustration.

Fig. 1 shows the female butterfly. She can be distinguished by the fact that her front wings have upon them two black spots, while there is but one black spot upon the front wings of the male. This butterfly deposits eggs upon cabbage, cauliflower, mignonette and several other plants. The eggs are very small, but when seen under a microscope they present a beautiful appearance, being of peculiar shape and neatly sculptured. These eggs hatch into the velvety green worms or larvae with which every cabbage grower is familiar. It is unnecessary to describe the work of these worms. They eat large, ragged holes in the leaves of the cabbage, and as the latter matures they even eat a considerable distance into the head itself. When this worm has completed its growth it seeks a suitable location and there changes to the chrysalis or pupal stage, in which it remains for some time. From this chrysalis the adult butterfly hatches or emerges and another life history is then repeated. There are perhaps as many as five or six generations of the cabbage worm in Louisiana each season.

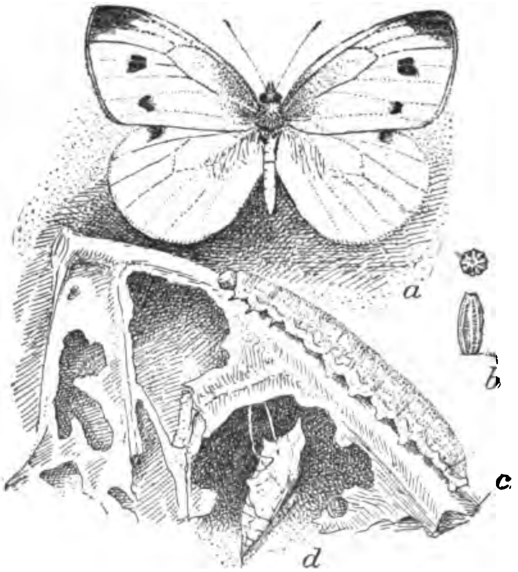

Fig. 1.—The imported cabbage worm: *a*, female butterfly; *b*, above, egg as seen from above; below, as seen from side; *c*, larva in natural position on cabbage leaf; *d*., suspended chrysalis—*a*, *c*, *d*, slightly enlarged; *b*, more enlarged. (After Chittenden, Cir. 60, Bur. Ent., U. S. D. A.)

Remedies.

The most important step of all is cleanliness, and methods of clean culture about the garden. As soon as the crop of cabbage or cauliflower is harvested all of the remaining stalks, useless plants and leaves should be gathered up and burned. If any useless or stray plants be left about the garden these will simply serve as breeding places for this insect and will greatly increase the number of worms which will appear upon the next crop. Were the truck growers of any one neighborhood to unite and systematically clean up all refuse plants and leaves as early as possible after each harvest, this insect would probably be so reduced in numbers as to be of little importance. Under present circumstances, however, the gardener is compelled to fight the cabbage worms almost from the day his cabbage plants are set out. During the *early* growth of the cabbage plants they can best be fought by spraying the plants occasionally with Paris green solution made of one pound of Paris green and two pounds of lime in 150 gallons of water. The danger from using Paris green in the dust form is that we are liable to apply too much of it and injure the plants.

Arsenate of lead is not a suitable arsenical to use upon cabbages for the reason that it is very tenacious and is not washed off by rains. What we want for cabbages is an arsenical poison which will kill the worms, but which will at the same time be washed off by the rains, so that by no chance will any of it remain until the cabbages are harvested. The Paris green spray can be used upon the cabbages safely until the heads are about half grown. After that time it is better to use applications of pyrethrum, as this latter substance is not poisonous to human beings. An authentic case of people being poisoned as a result of Paris green being used upon cabbage has not yet come to light, but it is doubtful if anyone wishes to experiment along this line. In reality there is far more Paris green used upon the cabbage crop of this country than most of the grocers' customers ever dream of.

Hot water at a temperature of 135 degrees will kill the cabbage worms when it comes in contact with them, and at this temperature the water will not injure the cabbages. In small garden patches the teakettle and the housewife make a dangerous combination for the cabbage worm! When hot water is employed a water or dairy thermometer must always be used to get the correct temperature.

THE HARLEQUIN CABBAGE-BUG.

(*Murgantia histrionica* Hahn.)

This red and black creature is a native of Mexico and Central America, from whence it has spread all over the Southern States. It is a sucking insect and cannot be affected by the application of poisons. It is primarily an enemy of cabbage, cauliflower and similar plants, which it injures by sucking the sap from leaves and stems.

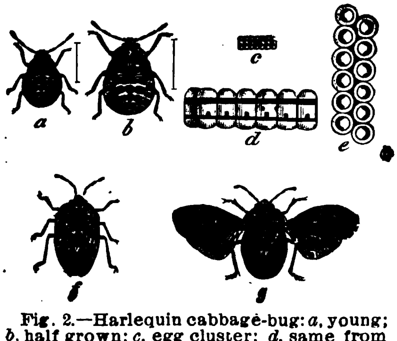

FIG. 2.—Harlequin cabbage-bug: *a*, young; *b*, half grown; *c*, egg cluster; *d*, same from side; *e*, same from above; *f*, adult, wings closed; *g*, same, wings open; *c*, *f*, *g*, natural size; *a*, *b*, slightly enlarged; *d*, *e*, considerably enlarged. (From Riley, Div. Ent., U. S. D. A.)

Here again, clean culture is a prime requisite to immunity from damage by the pest. After the crops are harvested, all refuse should be burned up.

The insect hibernates in the adult stage and the adults make their appearance early in spring. In small garden patches they can be trapped by placing a few cabbage leaves about the garden and destroying the bugs which accumulate on them. If a few mustard plants be provided early in spring the bugs will collect upon these and they can be easily killed by spraying the plants wtih pure kerosene or Beaumont petroleum. Every insect killed in early spring is equivalent to the destruction of many hundreds later in the season, hence the advantage of taking pains to secure every hibernating individual possible.

THE ONION THRIPS.

(*Thrips tabaci* Lind.)

This tiny yellow insect, hardly as big when fully grown as an ordinary pinhead, is a splendid exemplification of the old adage: "It's the little things in life that count." The thrips belong to the group of insects known as "fringe-wings" or "bladder-feet." They are slender and active, with the head so narrow as to make them appear pointed at both ends. Only the females are winged, the wings being laid longitudinally along the back, and equipped with peculiar fringes, as shown in the illustration. At the end of the feet are small, bladder-like distortions of the terminal joint.

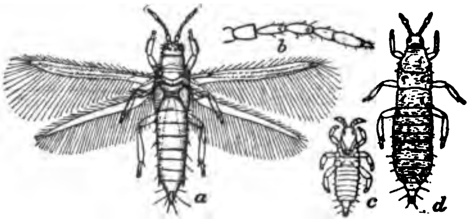

Fig. 3.—Onion thrips: *a*, adult; *b*, antenna of same; *c*, young larva; *d*, full grown larva—enlarged. (From Howard, Yearbook U. S. D. A., 1898, p. 143.)

This insect attacks onions, cabbage, cauliflower, kale, turnip, melons, pumpkins, squash, cucumber, tomato, and numerous other plants and weeds. Its principal damage, however, is done to onions, to a field of which this insect often gives the appearance described as "white blast." The thrips feed principally in the axils of the leaves and between the leaves where it is difficult to reach them with insecticides. Under conditions favorable for their development, such as hot, dry weather, they increase in enormous numbers and in a few days may cause an onion field to change from the normal dark green color to a sickly whitish yellow. The eggs are laid just beneath the epidermis of the leaf, and the young thrips resemble the adults very closely. Under the microscope the larvae are seen to have six joints in the antennae, while the adults have seven.

Treatment.

Clean culture is one of the principal steps to be taken in combating the onion thrips. As soon as the onions are harvested from an infested field, all tops and bulbs should be destroyed by burning. In this way thousands of the insects are prevented from hibernating. As far as possible all hedgerows, ditches, etc., should be burnt over, or, where this is not feasible, plowed.

Kerosene emulsion at a strength of about 12 per cent, sprayed upon the plants several times, is fairly effective in holding this insect in check, but this treatment on large areas requires special truck spraying machinery, and is rather expensive. However, where infestation starts along the edges of the fields, much good may be accomplished by giving these edges several thorough sprayings with the emulsion.

Spraying with cold water is valuable on small areas, as the thrips require dry plants and soil for their rapid development.

THE STRIPED CUCUMBER-BEETLE.

(*Diabrotica vittata* Fab.)

Several different beetles attack cucumber and melon vines, but the worst of these is the striped cucumber-beetle. It hibernates in the adult stage and is ready to attack the first cucumber and melon vines that appear above ground in the spring The eggs are deposited on the stems near the ground and these eggs hatch into small white worms which eat into the roots of the vines below the earth. Hence the pest attacks the plants both above and below ground, making it doubly injurious.

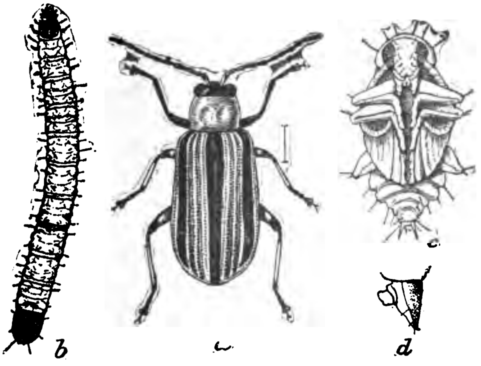

Fig. 4.—Striped cucumber-beetle: *a*, beetle; *b*, larva; *c*, pupa; *d*, anal segment from side: all enlarged to same scale except *d*, which is more enlarged. (After Chittenden, Bul. 10, n. s., Div. Ent., U. S. D. A.)

With this insect, as with the cabbage worm, much exemption from injury may be secured by cleanly methods of gardening. As soon as a cucumber or melon crop is harvested the vines should be piled together, covered with straw and burned. A plant may be left here and there after the burning, to serve as a trap to attract the insects that escape the fire. These trap plants should be sprayed from time to time with Paris green. The great danger connected with the use of trap plants is procrastination on the part of the gardener. He leaves the trap plants, and if he remembers to spray them, well and good, but if he forgets to do it, his trap plants only furnish a convenient food supply for the insects.

Perhaps the most common method of preventing injury by this beetle is to cover the plants as soon as they come up with muslin or cheese-cloth covers, supported upon bent wires or wooden half-hoops (See Figure 5).

Arsenate of lead at a strength of 2 pounds to 50 gallons of water, sprayed upon the plants as soon as the beetles appear, has proven very effective in holding this beetle in check.

In lieu of a liquid spray, powdered arsenate of lead[2] may be dusted on the young plants every two or three days until they get well started and to growing rapidly.

Planting an excess of seed is also practiced, so that the injury will be distributed. After the worst attacks are over the plants remaining are chopped out to a stand. Another plan of protecting the cucurbit plants is to plant beans between the rows of cucurbits. The beetles will feed on the beans in preference to cucumbers or melons.

THE TWELVE-SPOTTED CUCUMBER-BEETLE.

(*Diabrotica 12-punctata* Ol.)

At times this beetle is fully as abundant and injurious to melons and cucumbers as the striped cucumber-beetle, described above. It is practically the same size as the striped beetle and is of the same yellowish green color. Instead, however, of being striped with black it has twelve prominent black spots upon its wing-covers or "back." The same measures should be taken against it as against the striped cucumber-beetle, and both insects can be fought at the same time.

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[2] There are two distinct forms of arsenate of lead. The "pulp" or paste form of lead arsenate has been in use for a number of years and is always applied as a liquid spray in water. *Powdered* arsenate of lead is of essentially the same chemical composition as the paste arsenate, but is an insecticide of recent development, having been first produced during the course of experiments by the State Crop Pest Commission of Louisiana. Is is more effective against biting insects than is Paris green, costs less, will not injure foliage and is destined to largely supersede Paris green where an arsenical insecticide in powdered form is required.

COLORADO POTATO-BEETLE.

(*Leptinotarsa 10-lineata* Say.)

Shortly after the Civil War this insect created almost as much excitement as the boll weevil is causing at the present time. It was originally a native of the extreme western States and its favorite food plant was the sand bur, *Solanum rostratum* As the Western States were settled up and the growth of Irish potatoes extended westward this beetle found them to be far nicer food than wild, tough sand burs, and it shortly bcame a serious pest. Its spread eastward and southward was rapid, and it now occupies nearly all the territory east of the Rocky Mountains. This insect is also interesting in that it was largely responsible for the first general use of Paris green as an insecticide.

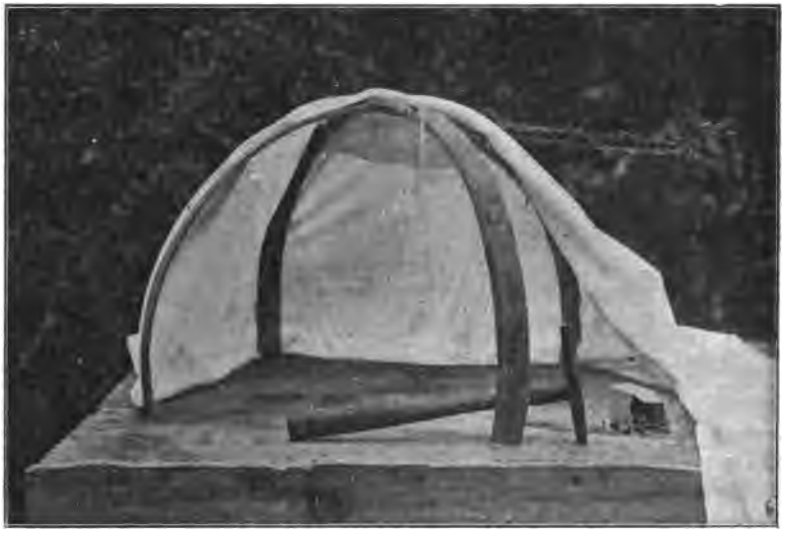

Fig. 5.—A cheap and simple cover for protecting young melon and cucumber plants from beetles—method of constructing it from old barrel hoops and ordinary cheesecloth. (Original.)

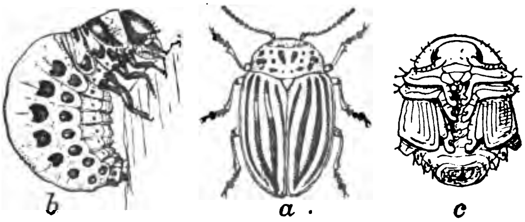

Fig. 6.—Colorado potato-beetle: *a*, beetle; *b*, larva; *c*, pupa—enlarged. (After Chittenden, Cir. 87, Bur. Ent., U. S. D. A.)

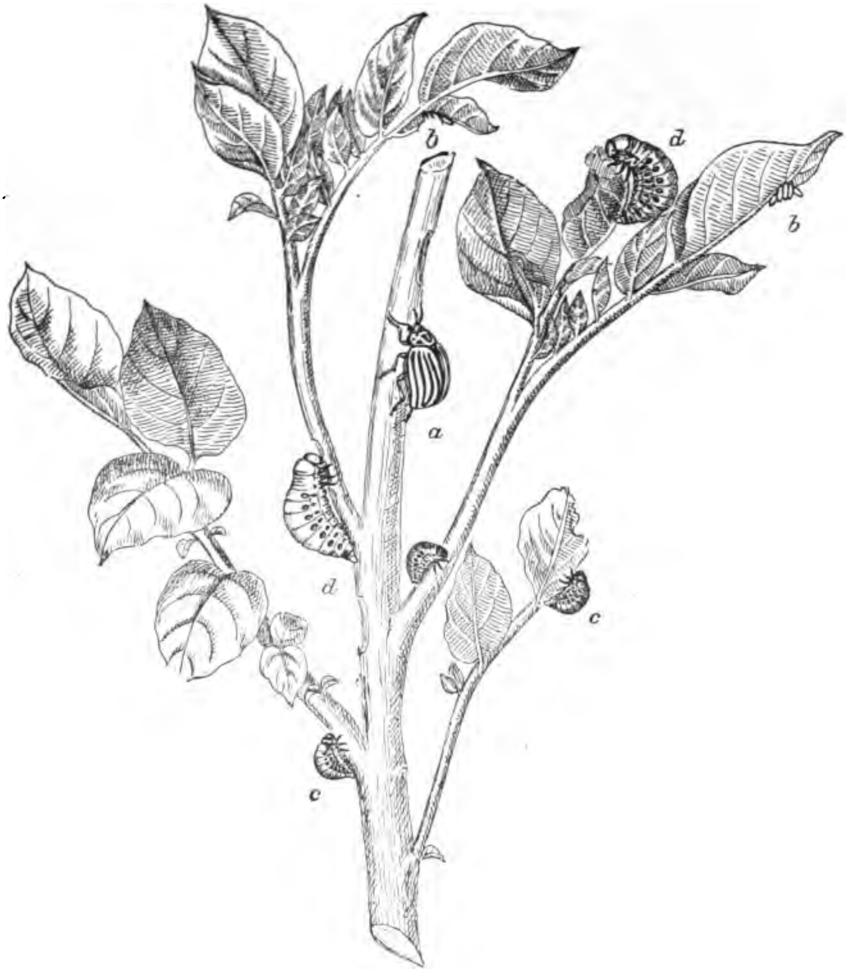

Fig. 7.—Section of potato plant, showing Colorado potato-beetle at work: *a*, beetle; *b*, *b*, egg masses; *c*, *c*, half grown larvae; *d*, *d*, mature larvae—somewhat enlarged. (After Chittenden, Cir 87, Bur. Ent., U. S. D. A.)

The winter is passed in hibernation and the first appearing beetles of spring deposit their eggs upon the potato plants. The eggs hatch in about one week into the reddish, repulsive looking larvae. These latter grow rapidly and when mature enter the ground and form pupal cells in which they later transform to adults.

Applications of Paris green or arsenate of lead to the plants, in the form of a spray, is, as every trucker knows, fully effective in keeping down the pest. The beetle also has many natural enemies—other insects—which attack it with greater or less severity. This accounts for its decreased numbers in certain seasons.

A suitable spray is composed of one pound of Paris green and two pounds of lime to 150 gallons of water, and a better one is two pounds of arsenate of lead to 50 gallons of water. Arsenate of lead is not washed off readily by rains, hence is efficacious for a much longer period than is Paris green.

A treatment likely to prove even more satisfactory is that of applying powdered arsenate of lead (see footnote, page 100) to the plants at the rate of from 1 to 2 pounds per acre, using a suitadle dust-spraying apparatus for making the application.[5]

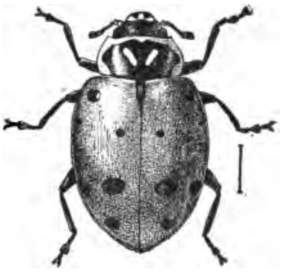

Fig. 8.—A ladybird (*Hippodamia convergens*) which preys on the Colorado potato-beetle—enlarged. (After Chittenden, Cir. 87, Bur. Ent., U. S. D. A.)

THE POTATO STALK-BORER.

(*Trichobaris trinotata* Say.)

This is an insect of considerable importance in parts of eastern Texas, but we have not yet heard of its occurrence in this State. The larvae bore inside the stem of the growing plant and as the adult weevils are small, the insect can be easily overlooked and the damage readily attributed to blight, dry weather or other causes. It is not unlikely that the insect occurs here and there in Louisiana, particularly in the western and southwestern portions, and potato growers should be on the lookout for it. Unless controlled by suitable measures its increase to alarming numbers is likely to follow the growth of Irish potatoes on a large scale season after season. Potato plants which show a wilted or

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[5] For making applications of powdered arsenate of lead we have had excellent results with the "Champion dust gun," a small machine which can be carried by hand and which forces the poison in among the leaves with a steady blast of air. The dust gun costs $7.50 and can be secured from the manufacturers, Leggett & Bro., 301 Pearl St., New York, or from the Doherty Hardware Co., Baton Rouge, La. We have tried other devices for applying poison in dust form, but have not found any that work satisfactorily.

"blighty" appearance should be split open and if this insect is causing the damage its whitish larvae will be found. The larvae are also found in a number of plants besides the potato, notably in eggplants, nettles and "jimson weeds." Regarding remedial measures for the pest, Prof. F. H. Chittenden, of the United States Department of Agriculture, says:

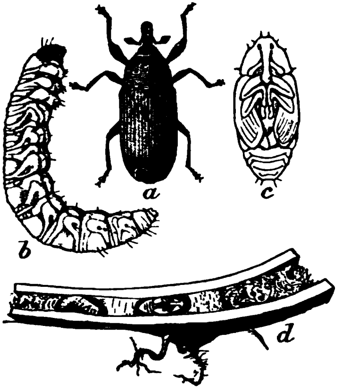

Fig. 9.—Potato stalk-borer: *a*, beetle; *b*, larva; *c*, pupa; *d*, section of potato stalk opened to show larva and pupa *in situ*; *a*, *b*, *c*, five times natural size; *d*, natural size. (After Chittenden, Bul. 33, Div. Ent., U. S. D. A.)

"The best remedy is to pull infested vines as soon as they wilt and show evidence of attack, and spread them out so that they will be exposed in the sun and will dry and thus prevent the escape of the insects which they contain. All stalks in infested fields should be burned as soon as the crop is off. This will greatly lessen the number of weevils for the ensuing years. It is also advisable to keep down all solanaceous weeds. The time for their destruction is after they have attracted the beetles for egg laying, or any time before the tubers are ripe. The use of fertilizers will often aid injured plants to recuperate from attack. Unfortunately, injury is not apt to be detected until the plants begin to die. As soon, therefore, as a plant shows weakness its stalk should be split open to ascertain the cause."

THE SWEET POTATO WEEVIL.

(*Cylas formicarius* Fab.)

This is one of the most destructive, and at the same time most difficult insects in the State to control. In appearance it somewhat resembles an ant, hence the Latin name of *formicarius*, from the Latin *"formica,"* meaning ant. This insect is well distributed through the sweet potato sections of southern Louisiana, and causes a loss amounting to thousands of dollars annually. It was first reported in this country in 1875 and was probably introduced from the West Indies.

The adult insect is a weevil, or "snout beetle," elongated in shape, smooth and glossy. The head is black, the thorax and legs red, and the abdomen a dark steel-blue. The average length is about one-quarter of an inch.

The eggs are very small, yellowish white in color, and from 1-40 to 1-50 of an inch in diameter. They are laid in cavities made by the mother insect either in the vines or tubers. When in the former they are usually laid in the lower portions.

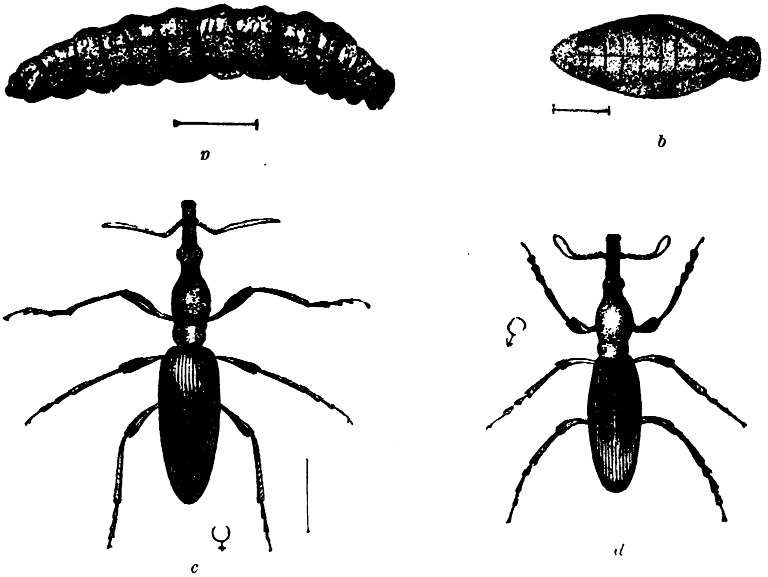

Fig. 10.—Sweet potato weevil: *a*, grub or larva; *b*, pupa, dorsal view; *c*, adult female: *d*, adult male—hair lines show natural size. (After Morgan, Bulletin 28, La. Experiment Stations.)

From the egg hatches a minute, white, footless grub, having a pale brown head. If on the plant, these little larvae begin immediately to tunnel toward the tuber, and if on the tuber, they soon riddle it with numerous galleries. In about two weeks the larva has fed sufficiently to be ready for pupation. This is accomplished in its gallery, after sealing the channel with some of its excrement.[4] When full grown the larva is from 1-5 to 1-2 inch in length.

The pupa is somewhat smaller than the full grown larva, and can be easily distinguished from it by the presence of the forming appendages of the adult insect. This stage occupies about a week or ten days, depending upon the temperature.

Under normal conditions about five weeks are required for a generation, so that there are probably four or five generations of the sweet potato weevil in Louisiana.

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[4] Conradi, Tex. Agr. Exp. Sta., Bulletin No. 93.

Treatment.

No one plan of treatment is successful against this tireless little pest, but a combination of measures must be used. Pre-eminent among these measures are those of getting seed potatoes from uninfested sections and rotating crops, i. e., not planting potatoes on a field which was in potatoes the year before. The practice of gathering volunteer slips from tubers left in the ground from the preceding season should never be practiced in a weevil-infested section, and seed potatoes shipped in from uninfested sections should be carefully packed so as to avoid infestation en route. Plants related to the sweet potato vine, such as the morning-glory, should be kept down in the vicinity of the potato patch. Tubers should be boiled before feeding to cattle, and an infested crop should be burned, not buried as is often practiced.

The potatoes, when harvested, should be carefully gone over before being stored, and all infested tubers thrown out and burned, or boiled and fed to cattle, and the field cross-harrowed after harvesting. It is a good idea to turn hogs into the field, as they destroy a large number of the infested tubers left in the ground. After sorting, the potatoes should be placed in a storage bin that is absolutely weevil-proof.

While no amount of fumigation will save tubers that are infested, the weevils already in the bins may be destroyed by fumigating the bins with carbon bisulphide, or "high life." In using this substance it should be remembered that it is highly inflammable, and no lights, pipes, cigars or cigarettes should be allowed in or near the building while fumigation is gong on, nor afterwards, until the building has been thoroughly ventilated. The carbon bisulphide should be used at the rate of 1½ pounds to every 1,000 cubic feet of space in the bin, or to every 100 bushels of potatoes, placing the liquid in shallow vessels above the potatoes, as the carbon bisulphide vapor is heavier than air and sinks to the bottom of the enclosed space. The bin must, of course, be perfectly tight and the fumigation may be repeated whenever necessary.

Many weevils may be trapped early in the spring by placing tubers around the field for several weeks before the crop is planted, keeping the places where these tubers are placed carefully marked. These should be frequently and carefully examined, and destroyed about a week after the first weevils are noticed on them, repeating the operation with fresh potatoes as long as the weevils continue to be attracted to them.

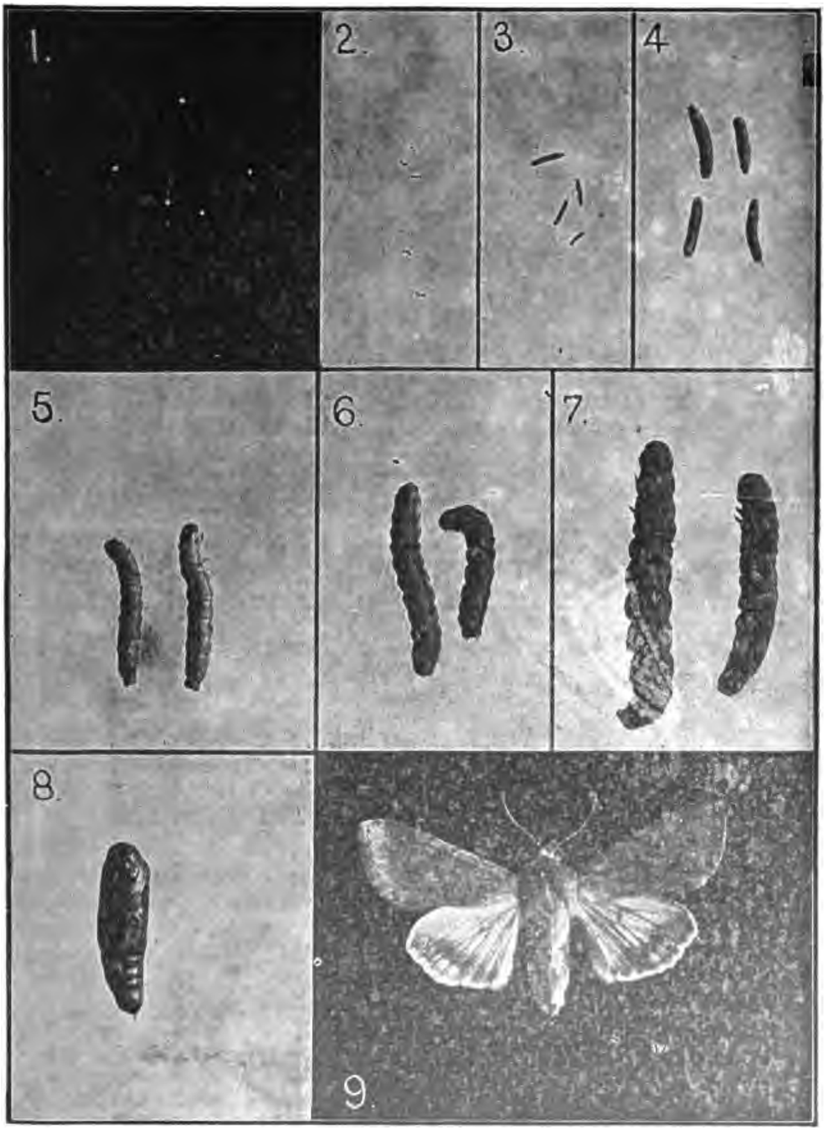

Fig. 11.—Stages in the life history of the boll worm: 1, eggs on corn stalks; 2-7, larvae, first to sixth instars, respectively; 8, pupa; 9, adult female moth—all figures enlarged one-fourth. (After Quaintance and Brues, Bul. 50, Bur. Ent., U. S. D. A.)

THE BOLL-WORM, OR "CORN EAR-WORM."

(*Heliothis obscura* Fab.)

The boll-worm of cotton and the ear-worm of corn are one and the same insect. It is a pest which feeds upon a great variety of plants. It is sometimes injurious to beans, the worm eating its way into the green pod and destroying the developing beans within. It is also not infrequently the cause of injury to ripening tomatoes. While rather efficient methods are known for controlling this pest in cotton and corn fields[5] it is a difficult insect to control in gardens. However, since corn is its favorite food plant the beans and tomatoes can be to some extent protected by the early planting of an early variety of corn near or with the beans and tomatoes. When sweet corn is to be grown for the market the ground should be plowed in December and thoroughly disc-harrowed from two to four times before February 1, in order to expose to weather and birds the underground cells in which the worms pass the winter. Extremely early planting of the sweet corn crop is also to be advised so that as many ears as possible will reach marketable condition before the season of greatest boll-worm damage is at hand.

THE DESTRUCTIVE PEA-APHIS, OR GREEN PEA-LOUSE.

(*Nectarophora pisi* Kalt)

In 1900 it was estimated that this insect cost the pea growers of the Atlantic Coast States something over $4,000,000.00. Johnson[6] very realistically describes a pea field badly infested with the green pea-louse in the following words:

> "Without a question of a doubt the destruction caused by this insect * * * is the most complete I have ever experienced. It is certainly a sad sight to look over a 100-acre field of peas and see them literally encrusted and covered with this insect. * * * It is one of desolation. As far as one can see the plants are shriveled, withered, and in many cases the leaves are blackish, looking as if a fire had gone over the surface of the ground, scorching them. The whitish cast skins of the insects stuck to the drooping leaves in the honey-dew, which had been excreted by the insects everywhere over the entire field, gave one the impression that a terrible plague had surely visited that section."

The green pea-louse is a typical aphis, or plant-louse, but of unusually large size, the full-grown winged females being about 3-16 of an inch in length, with a wing expanse of about 2-5 of an inch. It is a uniform pea green in color, with prominent, reddish brown eyes and with the antennae lighter than the body. Like all plant-lice, they obtain sustenance by inserting their long, slim beaks into the tissues of the plants and sucking the sap; hence none of the ordinary poisons are effective against them.

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[5] See Circular 19 of the State Crop Pest Commission.

[6] Bul. 20, n. s., Bur. Ent., U. S D. A., p. 94.

Reproduction is of two kinds, some females producing living young, while, in the fall, females lay eggs to carry the species through the winter season.

The lice begin their attacks upon the young terminals, but as they increase in numbers, and the leaves become overstocked, they turn their attention to the stems and soon sap the life from them.

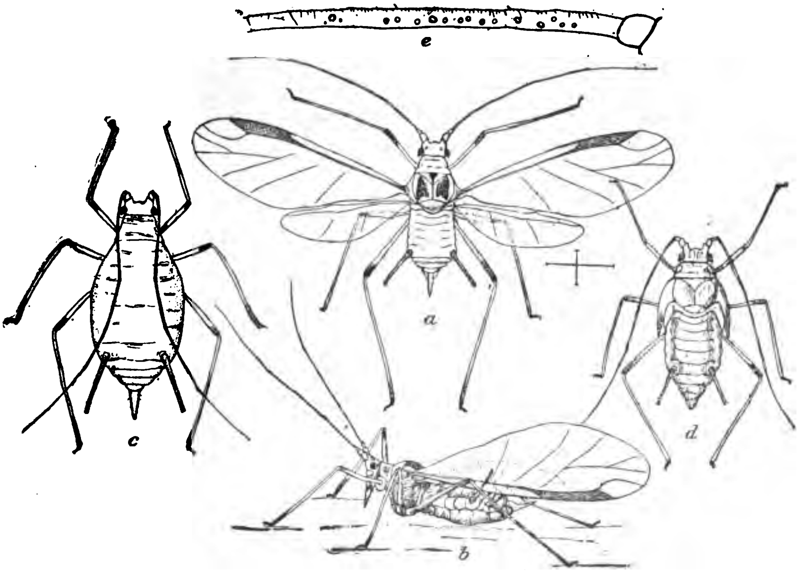

Fig. 12.—Destructive pea-aphis: *a*, winged female; *b*, same from side with wings folded in natural position when feeding; *c*, apterous female: *d*, nymph in last stage; *e*, third joint of antenna of winged form; *a*, *d*, much enlarged; *e*, more highly magnified. (After Chittenden, Cir. 43, Div. Ent., U. S. D. A.)

Controlling the Lice.

While a 10 per cent or 12 per cent kerosene emulsion, or a whale-oil soap solution made at a strength of about one pound of whale-oil soap to six gallons of water, is fairly effective, these mixtures are very difficult of application on account of the necessity of under-spraying, and more expensive than the brush and cultivator method, which is the simplest method of combating these insects.

In using this method, however, it is essential that the peas be planted in rows 24 or 30 inches apart, so as to allow of cultivation, *not in drills as ordinarily done*. Then, at the first appearance of the lice two boys or men walk in the open spaces between the rows, leaving one space between them, and brush the lice off the vines into this space with brooms made of freshly cut pine branches. Behind them, in the middle space, should come the cultivator, which buries the lice, or kills them by stopping up their breathing pores with dust. This should be done during the hottest part of a clear day, as a number of the lice are simply roasted when they fall upon the hot soil. Treatment should be repeated at intervals of from three to ten days, as long as is necessary. This method of treatment has not only the

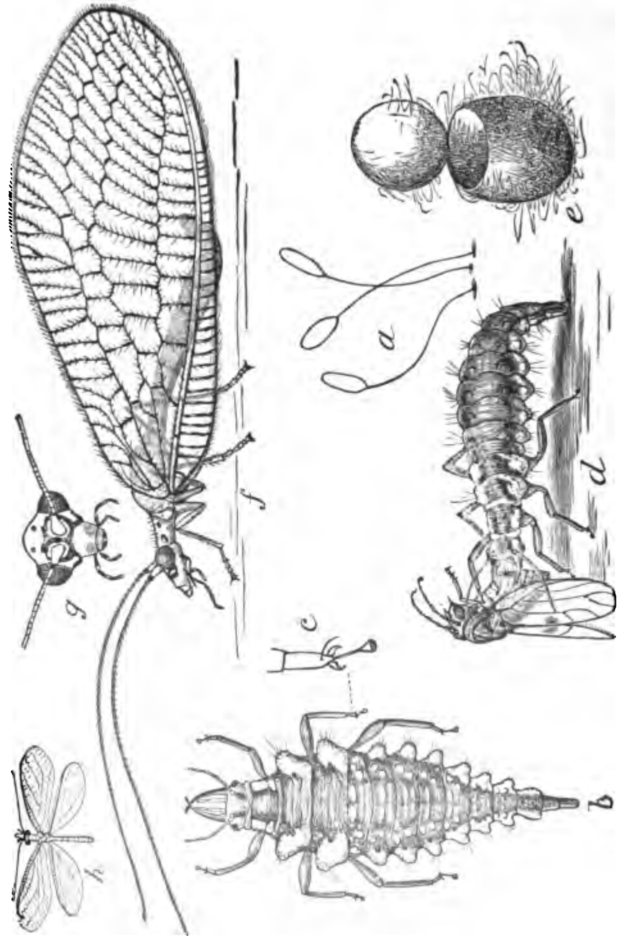

Fig. 13.—A lace-wing fly (*Chrysopa oculata*) which is a valuable preduceous enemy of the green pea-louse: *a*, eggs; *b*, full-grown larva; *c*, foot of same; *d*, same devouring pear-tree psylla; *e*, cocoon; *f*, adult insect; *g*, head of same; *h*, adult, natural size—all enlarged except *h*, which is natural size. (From Marlatt, Div. Ent., U. S. D. A.)

advantage of being inexpensive, but also that of not destroying the natural enemies of the pea-louse, which are very numerous. Most of these natural enemies—lace-winged flies, syrphus flies, lady-bugs, etc.—are much less delicate in structure than the aphis, and the brushing will not materially reduce their numbers.

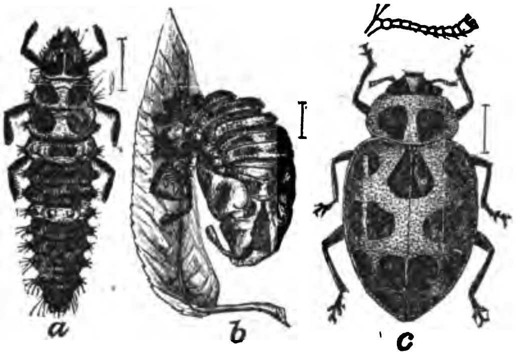

Fig. 14.—A ladybird enemy (*Megilla maculata*) of the destructive green pea-louse: *a*, larva; *b*, empty pupal skin; *c*, beetle with enlarged antenna above—all enlarged. (After Chittenden, Cir. 43, Div. Ent., U. S. D. A.)

Another method of fighting these insects which has proved quite effective, especially on small areas, is to draw long, shallow pans, in which a little kerosene is floating, between the pea rows, brushing the lice into them, where they will be instantly killed. Chittenden[7] mentions an instance where a bushel of lice was caught by this method from every row of peas one hundred and twenty-five rods long.

One of the most promising natural enemies of the green pea-louse is a fungus disease (*Empusa aphidis*), which grows upon the bodies of the lice. This fungus has been of great value in the East, and the Crop Pest Commission hopes to shortly be able to introduce it into Louisiana.

THE BEAN LEAF-BEETLE.

(*Ceratoma trifurcata* Forst.)

This is a native insect, and has been known as an enemy of beans since 1876, when Prof. E. A. Popenoe[8] described it as "eating the leaves of the dwarf beans to such an extent as to destroy the plants." They attack not only beans, but cowpeas, and several wild plants, such as bush clover (*Lespedeza spp.*), the hog peanut (*Falcata comosa L.*), and tick trefoil (*Desmodium spp.*). Of the latter it appears to be particularly fond. The beetles do their injury by eating large holes in the leaves of beans

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[7] Cir. 43, Sec. Ser., Bur. of Ent., U. S. D. A.
[8] Trans. Kans. Acad. Sci., 1876, p. 35.

and cowpeas, often stripping the leaves to the veins and midribs. The larvae also damage the plants by feeding upon them at the base.

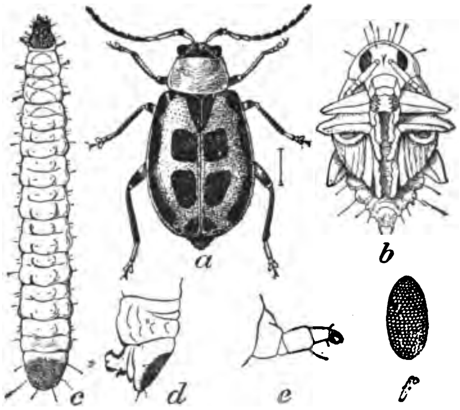

Fig. 15.—The bean leaf-beetle: *a*, adult beetle; *b*, pupa; *c*, larva; *d*, side view of anal segment of larva; *e*, leg of same; *f*, egg—*a*, *b*, *c*, enlarged about six times; *d*, *e*, *f*, more enlarged. (After Chittenden, Bul. 9, Div. Ent., U. S. D. A.)

The insect can be easily recognized from the illustration. The beetle is about 1-6 of an inch in length, and about half as wide, the color of the wing covers varying from yellow to red, generally being marked along the edges with black, and having two conspicuous black spots on each elytra. In many specimens, however, these markings are entirely absent.

The eggs are very minute, orange in color, and are laid in small clusters around the base of the plant. The larvae are white or very light yellowish in color, with both extremities darker. They feed by eating around and within the stem. The pupa is white in color, and also easily recognizable from the illustration.

Arsenate of lead, at a strength of two pounds to fifty gallons, or a Paris green solution made as recommended for cabbage-worms, sprayed upon the beans at the first appearance of the beetles will greatly reduce them. Care should be taken to get the arsenical upon the under surface of the leaves, as it is here that the beetles feed most abundantly.

The wild host plants, such as the tick-trefoil, hog-peanut, etc., should be destroyed or heavily sprayed with lead arsenate or Paris green, caution being exercised to keep stock and children away from such poisoned plants.

THE ARGENTINE ANT.

(*Iridomyrmex humilis* Mayr.)

The small dark brown ant, so common in New Orleans, Baton Rouge and other southern Louisiana and Mississippi towns, known as the Argentine or "New Orleans" ant, is often-times a cause of considerable annoyance to gardeners. The workers have a most aggravating habit of digging up lettuce seed as soon as it is sown and carrying it away to their nests. The writers have tried, without success, heavy applications of lime, sulphur and tobacco dust, respectively, on the lettuce beds after being sown. The ants pay little attention to these substances and burrow through them to get the lettuce seed almost as readily as through soft earth. On the grounds of the Experiment Station at Baton Rouge it has been found that the ants are as fond of corn meal as of lettuce seed, and if fine corn meal is sifted liberally over the beds when the seed is planted, the ants will engage

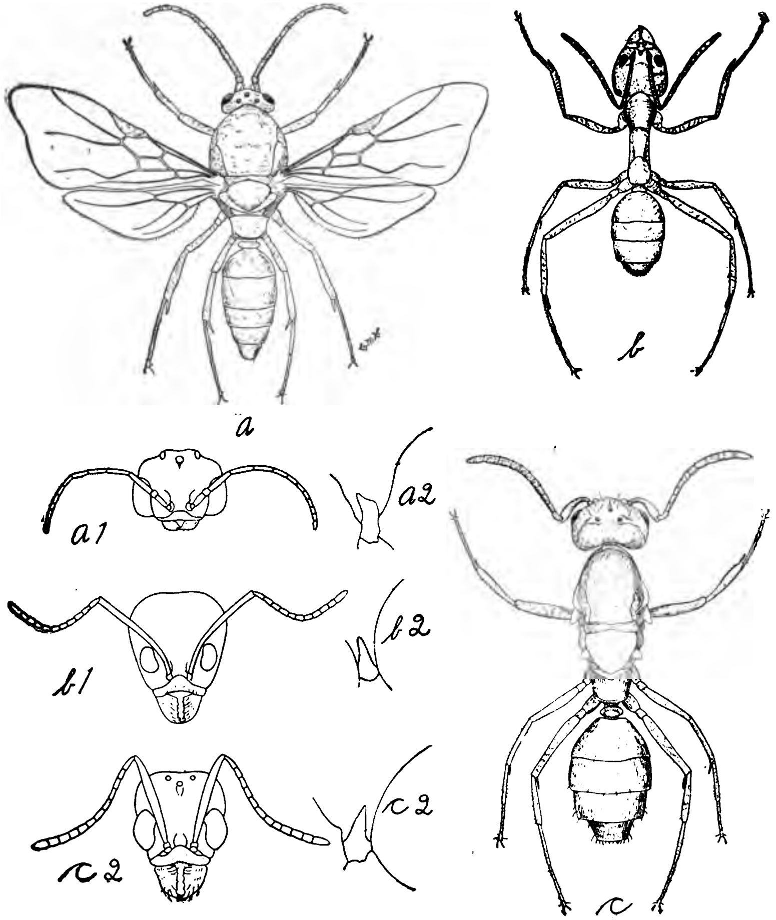

Fig. 16.—The Argentine ant: *a*, adult male; *a1*, head of male; *a2*, petiole of male; *b*, worker; *b1* head of worker; *b2*, petiole of worker; *c*, fertile queen; *c2*, head and petiole of fertile queen—all greatly enlarged. (Senior author's illustration, from the Journal of Economic Entomology, Vol. II, No. 2.)

themselves in carrying this away. If sufficient quantity of the meal is put out, the seed will have germinated by the time the ants finish their self-appointed task of removing the meal and by that time the young plants will be safe from their attack.

No other case of these ants being destructive to vegetables proper has come to our attention, but they are destructive to cultivated flowers of various kinds, such as chrysanthemums, by eating the small flower buds. They are also indirectly responsible for much injury by plant-lice and scale-insects to various shrubs, trees and cultivated plants. The worker ants constantly attend the plant-lice and larvae of the white-fly to secure the honey-dew secreted by these insects. They doubtless also protect these insects from natural enemies, such as lady-bird beetles and parasites. Very severe infestations by all kinds of plant-lice and scale-insects are the rule where these ants are abundant.

To fight the ants with any degree of success the gardener must know something of their life-history. The ants live in colonies, these colonies establishing themselves in the earth, in decaying wood, in rubbish, under boards and fences, and in a variety of places. In each colony there are two, and at times three, different kinds of individuals. The most abundant individuals are the workers (see *b*, Fig. 16), which construct the galleries, feed the young and forage over the adjacent territory for food with which to supply the main colony. The workers are the ones which are guilty of getting into sugar, syrup, honey, lard and other foodstuffs and of caring for the various insects mentioned above. In each colony there is at least one queen, and in large colonies any number of queens. The queen has but one function, and that is to deposit the minute white eggs which hatch into little footless larvae or "grubs" (Fig. 17). The males (*a.*, Fig. 16) appear in the spring of the year. They are comparatively large winged creatures, and disappear by the middle of June.

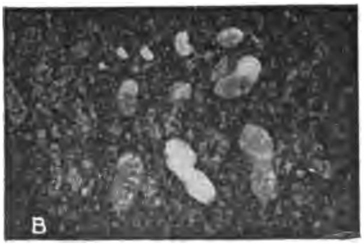

Fig. 17.—Immature stages of the Argentine ant (worker). The smaller objects are larvae in various stages of growth, while the two irregularly shaped individuals are pupae. (Senior author's illustration, from Journal of Economic Entomology, 1909.)

As cool weather approaches in autumn various ant colonies unite with each other, particularly if suitable nesting quarters are at hand. At this season these large colonies take readily to any warm, relatively dry situation where they can pass the winter to good advantage. We have therefore been successful in destroying whole colonies, containing thousands of ants and hundreds of queens, by a "winter trap" prepared in the following manner:

About October 1 a wooden box about 2x3x2 feet (see Fig. 18) is placed near the center of the garden or yard and filled with a mixture of cotton seed and straw or dry grass. The top is left exposed to the weather so that rain will moisten the mass and start decay. The decaying interior becomes heated, and as winter approaches colony after colony of the ants migrate, with queens and larvae, to the warm portions of the trap. By January 1 the box is literally swarming with ants, and on a cool day, when the ants are sluggish, the box is covered with an airtight canvas and from one to three pounds of "high life" (carbon bisulphide) poured into the box. Suffocation of all ants and larvae follows. As carbon bisulphide is both inflammable and explosive, all fire must be kept many feet from where it is stored or used.

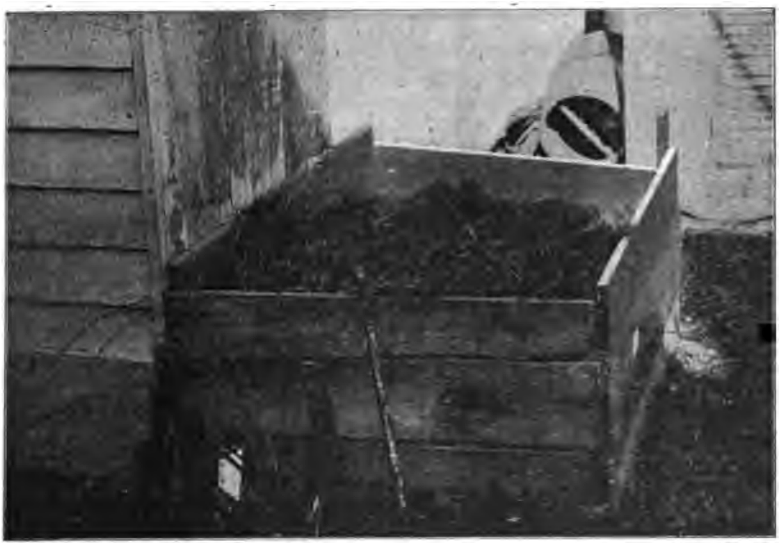

Fig. 18.—A winter trap for destruction of Argentine ants. The heat generated by the decaying mass attracts the ants in large numbers and during the winter they are destroyed by fumigating the contents of the box. (Original.)

As the queens are the only individuals which lay eggs and as they alone are responsible for future generations any measure which does not accomplish *their* destruction is futile. Killing them in winter by means of such a trap as described is more effective than the destruction of millions of workers by other means during the summer months. Much can be accomplished, however, during the summer by destroying every colony of the ants, large or small, found on the premises. When the colonies occur in the ground a sharp stick should be run into the nest and a sufficient amount of carbon bisulphide or gasoline poured in and all openings to the nest closed with packed earth. A small air-pressure spray pump, filled with crude petroleum ("Beaumont oil") is useful for destroying all colonies which may be located in rubbish, under boards, etc. The persistent location and destruction of all colonies is the only means of permanent relief from this pest that can be secured.

WIRE-WORMS.

Wireworms are the larvae of the so-called "click-beetles," or "snapping bugs." They are long and slender, with hard bodies showing distinct segmentation, and generally flattened toward the ends. The species vary from ½ inch to 2 inches in length, and the prevailing colors are yellowish or reddish. They are often found attacking garden crops, especially potatoes, into which they frequently bore. Their attacks are always worse on land that has been in grass or meadow for a year or so before, as the mature beetles generally deposit their eggs in grassy places. It is thought that most species require two years for their development, hence crops the second year after grass are often worse affected by wireworms than those of the first year. The winter is usually passed in little cells in the soil hence a good fall plowing and several harrowings during the winter are indicated as preventive measures. This may be supplemented by the use of poisoned baits in the spring and, as wireworms are fond of such places as those just beneath old planks laid on the ground, this bait should be placed in such situations. Corn soaked in arsenic water, baits of sweetened and poisoned dough, or thin slices of potatoes poisoned with strychnine will serve as attractive baits, and they also have the virtue of destroying numbers of cutworms at the same time.

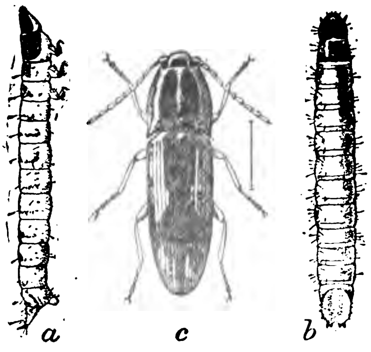

Fig. 19.—A wireworm beetle (*Monocrepidius vespertinus*): *a*, larva, side view: *b*, larva, dorsal view; *c*, beetle—all three times natural size. (After Chittenden, Bul. 33, n. s., Div. Ent., U. S.D. A.)

Before the main crop is planted, a number of wireworms may be captured by cutting slices of potatoes and placing them on the ends of sticks, burying these in the ground at frequent intervals over the field. When the wireworms collect on these potato cuts they can be lifted out by means of the sticks and destroyed with the worms.

Rotation of crops is, of course, necessary where the attacks of the wireworms are very severe. These insects do not seem to injure leguminous crops to any great extent, and Dr. S. A. Forbes, State Entomogolist of Illinois, proposes a rotation in which clover always follows grass, before the susceptible crops are planted on the land.

CUTWORMS.

There are very few gardeners who do not recognize the cause of young plants being severed at the surface of the ground soon after they are planted out. Cutworms are grayish or dirty brown in color, from 1 to 1½ inches in length. They are mostly nocturnal in habit, feeding during the night and remaining hidden away in the ground or under rubbish during the daytime. They are the larvae of dull-colored moths, which usually pass unnoticed by the truck grower and the farmer.

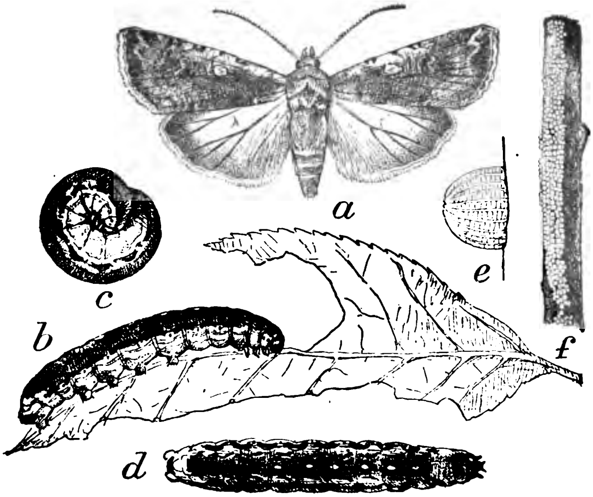

Fig. 20.—The variegate : cutworm (*Peridromia saucia*): *a*, moth; *b*, normal form of larva, lateral view; *c*, same in curved position; *d*, dark form, dorsal view; *e*, egg from side; *f*, egg mass on twig (After Howard, Div. Ent., U. S. D. A.)

Fall or winter plowing is partially effective in reducing the numbers of these insects since most species of cutworms pass the winter as larvae, one-half or two-thirds ground, in the ground.

When cutworm damage to young plants is noticed the most effective step is to prepare and use poisoned baits, or poisoned bran-mash. This is prepared by taking about a pound of wheat or rice bran and mixing with it a small amount of white arsenic or Paris green and a half teacup of sugar or cheap molasses. Water is then added to this mixture and stirred until a sloppy mass, just thick enough to run easily through the fingers, is secured. This is distributed about the plants that are being attacked, or placed here and there about the garden under pieces of board. The cutworms are exceedingly fond of this poisoned mixture and when they eat it—exit cutworm! Of course, in the use of this poisoned mash, as well as in the use of other poisonous substances, precaution must be taken to prevent the accidental poisoning of children or domestic animals.

Some gardeners follow the custom of placing a protection around young tomato and other plants when they are set out. This protection may be in the form of old tin fruit cans with their bottoms removed, stuck down over the plant. Small pasteboard squares thrust into the earth, the plant standing inside of each, seem to be effective against most kinds of cutworms, as the worms seem to find no incentive to crawl over them to the plant within. In large market gardens this plan would be tedious and expensive, but it answers well in the small family garden where there are comparatively few plants of a kind set out at a time.

ARMY WORMS.

Of army worms there are several kinds, but our most abundant and injurious one in Louisiana is locally known as the southern grass-worm. Like the cutworms, army worms are the larvae of medium-sized moths. The term "army worm" has come to be applied to these creatures because they apparently appear suddenly and in enormous numbers. In reality, however the young worms are developing and in-

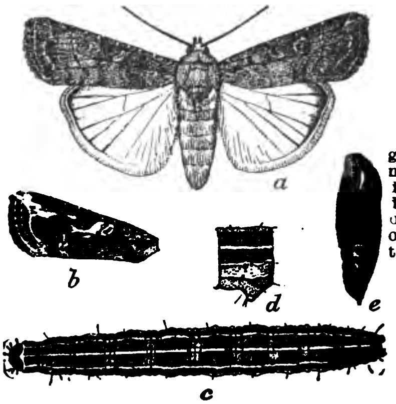

Fig. 21.—Fall army worm, or southern grass-worm (*Laphygma frugiperda*); *a*, moth, plain gray form; *b*, forewing of Prodenia-like form; *c*, larva extended; *d*, abdominal segment of larva, lateral view; *e*, pupa, lateral view; *d*, twice natural size: others enlarged one-fourth (After Chittenden, Bul. 23, n. s., Div. Ent., U. S. D. A.)

creasing in size for a considerable time before they are noticed. As they approach maturity their appetites seem to increase in a sort of geometrical progression, and when the farmer or gardener does notice their injury and looks a little more closely he finds them in tremendous quantity. Prevention is better than cure in the case of the grass-worms and in localities where they occur. no better step can be adopted than a thorough winter plowing and harrowing of the fields to turn up and break the pupal cells of the insect which occur just below the surface of the ground. Along fence rows and in situations where winter cultivation is not practical, a burning over of the ground during a dry winter day serves to destroy many of these insects.

When the army worms are comparatively few in number and occur here and there throughout the garden, the use of the arsenic bran-mash, recommended above for cutworms, will be found efficacious.

At times the army worms appear in large numbers and move forward in "armies," destroying practically all vegetation as they go. In such cases the best thing to do is to secure a good spray pump and a plentiful supply of crude petroleum and destroy the worms on the spot by spraying the advancing line. The oil will kill all vegetation it touches, as well as the worms, but in case of an outbreak of this character it is well worth the while to sacrifice a portion of the crop in order to stop damage by the worms.

GRASSHOPPERS.

Grasshoppers are of various kinds and sizes and in times of abundance cause not a little damage in the garden by consuming the leaves and stems of the more tender and succulent plants. The "hoppers" are given to feeding on a great variety of plants, but of the garden vegetables perhaps tomatoes and cabbage are most subject to attack. If the attack is made when the plants are *small*, many of the hoppers can be killed by spraying the plants with a mixture of arsenate of lead and water, two pounds of the poison in 50 gallons of the fluid.

Grasshoppers breed and frequent, for the most part, fields and vacant lots which have grown up to grass and weeds and from such situations they migrate to adjoining garden or field crops. The cotton planters of Texas have followed with success a unique method of protecting their cotton crops from these migrating hoppers. A mixture is made from one pound of white arsenic and about six gallons of cheap molasses. This is distributed in small streams along the edge of the cotton fields so that the hoppers encounter it as they enter the field. They eat it with avidity and with fatal effect.

A preparation found very effective in Canada for destroying grasshoppers is known as the "Criddle Mixture," and is prepared as follows: Mix together thoroughly one part Paris green, 40 parts fresh horse manure and two parts of salt by measure. Add enough water to make the mass soft but not sloppy. Distribute in small bits, but liberally, about in the field and particularly along the sides of the field adjoining pasture or fields "lying out." The mixture is said to be most effective while wet, but will continue to destroy the grasshoppers for a few weeks after put out even after having been washed more or less by rains.

When using the poisoned molasses or the Criddle mixture, the usual precautions must be taken to avoid the accidental poisoning of children or stock.

CULTURAL METHODS OF INSECT CONTROL.

Of far more importance than poisons and spraying machinery are the methods of cultivation employed by the gardener. We use the term "cultivation" in its broadest sense, to include crop rotation, clean culture, destruction of weeds and manipulation of the crop so that insect damage may be reduced to a minimum.

First of all, under this head, should be mentioned crop rotation. When one crop is grown season after season upon the same land the most favorable conditions possible are provided for the rapid increase of the insects attacking that particular crop. If, on the other hand, the crops be shifted about so that the same product will not be raised upon a given piece of land oftener than once in 5 or 6 years, the insects are literally "kept guessing" as to where their food-plant is going to be placed next.

To successfully outwit the insects the gardener and farmer as well, should plan his crop rotation well in advance and he should arrange it with regard to the insect enemies which experience has taught him must be dealt with. For example, he should always remember that lands in grass are the breeding places of cutworms, wireworms and grub worms and such land the first year in cultivation should not be planted to such crops as are particularly susceptible to damage by these insects.

Next in importance to rotation of crops comes clean culture. By this is meant the prompt removal of all stumps, leaves, vines and other fragments of every vegetable crop *immediately after harvesting.* Such refuse should be cleared thoroughly from the gardener's premises and it should be destroyed by *burning,* not by being thrown into a heap and left to decay. Unused portions of the crop, when left upon the field, merely furnish breeding places for the injurious insects and thus they provide a liberal supply of the pests to infest the following crop. Thus the inferior cabbages left in the field serve as breeding places for the cabbage-aphis and several kinds of cabbage-worms, the old squash vines produce squash-bugs and squash vine-borers, the melon and cantaloupe vines breed supplies of the striped cucumber-beetle. etc.

Late fall plowing and winter disc-harrowing or "dragging" are valuable means of destroying many insects which hibernate in the earth. Such winter treatment, in addition to being a good preventive measure against many insects, serves to aerate the soil and make the plant food in it more available for the crop to follow.

Many of the weeds which grow in and around gardens serve as food plants and breeding places to tide injurious insects over the interval from one crop to another. As a matter of business pride weeds should not be tolerated, but when one realizes that they are often responsible for direct damage to the crops themselves there is an added argument for keeping the premises free from them. In this connection it should be said that all litter, rubbish, brush and trash of all kinds should be kept from the garden and from adjoining premises as far as possible, for such materials serve as hibernating quarters and havens of refuge for the majority of noxious insects. Decaying logs and stumps should not be tolerated, for in them breed various larvae and particularly termites ("white ants") which are frequently the cause of unexpected losses.

We would again repeat that these simple measures, coupled with a little knowledge and common sense, are far more efficacious than are insecticides and proprietary nostrums.

FERTILIZERS.

Not infrequently certain brands of fertilizers are claimed by their makers to possess remarkable properties for destroying insects, such as wireworms, grub worms and the like. Occasionally unscrupulous parties will go so far as to insult the gardener's intelligence by telling him that the fertilizer contains some wonderful material which "will be taken up by the circulation" of the plant and that all insects feeding upon the plant will be killed by it!

With reference to the former claim it should be said that repeated tests have failed to show that fertilizer applied in any moderate quantity has any appreciable effect upon the insects in the soil. To destroy the insects effectively so much of the fertilizer would have to be applied that its cost would be prohibitive and the garden plants would themselves in all probability be destroyed by the excess.

The claim that plants can take up, through their roots, enough of a poison or fertilizer to destroy the insects feeding upon them is simply a fraudulent assertion. If the plants or vegetables could take up poison to kill the insects, they would be unfit for food, for the poison would be stored up in them and in their fruit where it would prove fatal to the human consumer. Plants and trees take up from the soil only such materials as are needed in their growth and development.

Fertilizers, as such, have a very proper place in the garden for stimulating the growth and abundant fruition of the plant,[9] and the judicious application of fertilizers often makes it possible for an insect-infested plant to flourish and produce fruit by growing so rapidly that the injury is overcome. This action of a fertilizer is, however, quite different from the idea that fertilizers will *kill* the insect pests.

INSECTICIDES.

The term "insecticides" is used to designate any material which may be used for the destruction of insects. A "repellent" is a substance used to drive the insects away from plants or certain areas.

A knowledge of insecticides and their use is imperative for the successful gardener. While, as already pointed out, much can be accomplished in preventing insect injury by proper cultural methods it often-times happens that the gardener has not planned his crop rotation and cultural methods successfully, or some unexpected pest makes its appearance in his field.

Thousands of dollars are annually wasted in the purchase and use of insecticides because the user does not know what kind of an insecticide is required for destruction of the pest at hand.

Broadly speaking, there are two classes of insecticides, those which act as poisons when eaten by the insect along with its food, and those which kill the insect by coming in contact with it and either corroding the body or stopping up the breathing pores.[10]

Generally speaking, the first class of insecticides is used for "biting insects," or those which actually chew their food, and the second class is employed against the sucking insects, or those which pierce the plants with a long pointed beak and suck the sap from within. The difference between these two classes of insects was discussed fully in the earlier part of this circular.[11]

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[9] A discussion of the fertilizers adapted to the different truck crops would be entirely outside the scope of this publication. Full information upon this phase of the subject can be secured from the bulletins upon truck growing published by the Louisiana State University Experiment Stations. These bulletins are free and can be obtained upon request from Prof. W. R. Dodson, Director, Baton Rouge, La.

[10] Insects do not breathe through nostrils, as do birds and mammals, but through small openings or "spiracles" situated in the segments or "joints" of the body.

POISONS.

ARSENATE OF LEAD, or lead arsenate, is one of the cheapest and safest arsenical poisons for use against insects which destroy foliage. It can be made from arsenate of soda and lead acetate, but as it is manufactured ready for use by a large number of firms, it is much more economical to purchase it already made than to attempt its manufacture at home. Its toxic action on insects is perhaps somewhat slower than that of Paris green, but as it does not contain any soluble arsenic when properly manufactured, there is no danger of foliage being scorched by it when used in reasonable quantities. As placed upon the market it is a heavy white paste. It is used only as a liquid spray, at the rate of from 1½ to 3 pounds to 50 gallons of water. To secure a uniform mixture which will not settle too quickly the desired amount of the paste is weighed out and with a very small amount of water mixed with a paddle until of a creamy consistency. This is then added to about three times its bulk of water and again thoroughly mixed, the resulting liquid being then added to the final amount of water and the whole thoroughly agitated. Frequent stirrings are necessary during spraying to prevent the heavy arsenate settling to the bottom of the vessel. On very tender foliage and for most biting insects a strength of 1½ or 2 lbs. per 50 gallons is sufficient, but in the case of insects which do not respond readily to the poison, when on hardy plants or shrubs, a strength of 3 or even 4 lbs. to the 50 gallons of water may be used. The use of lead arsenate has largely replaced that of Paris green in the large commercial orchards of the country. As an insecticide it is far preferable to either Paris green or London purple.

PARIS GREEN. This well known poison is a chemical compound of copper oxide and arsenious and acetic acids. It was the standard insecticide for use against biting insects until the discovery of lead arsenate, and even yet is extensively used owing to the fact that most people are familiar with it. The great drawback to its use lies in the fact that it contains from 2 to 4 per cent of soluble arsenious oxide, and this soluble portion exerts a poisonous effect upon the plants as well as upon the insects. It is now well understood that soluble arsenic may stunt the growth of plants and materially curtail their fruitage, even when it is not applied in sufficient quantity to make any immediate injury perceptible. When employed as a liquid spray about 1 pound of the Paris green is used in from 100 to 150 gallons of water. It is advisable to add to the spraying solution from 2 to 3 pounds of fresh lime for every pound of Paris green used. The lime neutralizes the free arsenious acid to some extent and thereby decreases the danger of injury to the plants. Paris green is sometimes applied in dust form, mixed with from 5 to 20 times its bulk of fine corn meal, road dust or hydrated lime.

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[11] See page 94.

Paris green is sometimes badly adulterated with foreign substances, but where effective laws are in force, requiring a certain standard of purity, as is the case in Louisiana, there is little danger of the buyer being imposed upon with an inferior article.

Of recent years Paris green has advanced considerably in price, and it is now about the most expensive arsenical poison that can be used for spraying purposes. Its price is largely controlled by a few manufacturers whose custom it is to charge as high a price for it as circumstances will allow. Fortunately the fruit growers and gardeners are no longer compelled to purchase it at "trust prices," for arsenate of lead is cheaper and is a far better insecticide. There is little doubt but what its place in the field of insecticides will be entirely taken within a few years by the arsenate of lead—the paste arsenate where a liquid spray is desired and the powdered arsenate of lead where an arsenical poison is desired for application in dry or powdered form.

POWDERED OR PULVERIZED ARSENATE OF LEAD, or lead arsenate. This is a product of recent development (see foot note, page 100). Chemically, it is essentially the same as the paste arsenate of lead, but being in the form of an impalpable powder can be applied in dry form and its use requires far less labor in the application, especially where a large area must be treated. It can be used for any biting insect, distributed at the rate of from 1 to 20 pounds per acre, according to the size of the plants. Ordinarily applications are made at the rate of about 2 to 3 pounds per acre. As this poison contains no soluble arsenic its use is not attended by any risk of injury to vegetation, and for the same reason it is unnecessary to dilute it with inert substances.

LONDON PURPLE. This article is a waste product in the manufacture of certain dyes. According to Lodeman[12] it is variable in composition and contains from 40 to 55 per cent of arsenic, considerable iron oxide, some aniline and a number of in-soluble constituents. A large proportion of the arsenic—usually from one-fifth to one-half—is soluble in water, which makes it a very dangerous substance to use upon growing vegetation. In the form of a liquid spray it is used at the strength of one pound to 200 or 300 gallons of water. Lime must always be added in considerable quantity to neutralize the free arsenic. As both Paris green and lead arsenate are far superior it is now rarely used by the more progressive fruit growers and gardeners.

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[12] Lodeman: "The Spraying of Plants," published by the Macmillan Co., New York, 1903.

CAUTION. All poisons should be kept in a safe place, securely sealed and labeled as to their dangerous nature. None of the insecticides herein mentioned should ever be left where children can get at them, or where they may accidentally come in contact with food or with feed which is to be used for stock. "An ounce of prevention is worth a pound of cure."

CONTACT INSECTICIDES AND REPELLENTS.

WHALE-OIL SOAP. Of all the substances used for killing insects by contact, whale oil soap is the most readily prepared. Being made from fish oil, it is a very different substance from ordinary toilet or laundry soaps. It is soft and greasy and possesses a rather unpleasant odor. It is used at the rate of 1 pound to from 4 to 10 gallons of water. The soap should be be weighed, then cut into very thin slices and dissolved in a gallon or more of water by boiling and stirring until all is dissolved. Water is then added to give the desired strength. To destroy scale insects on trees while the latter are dormant during winter, a strength of 1 pound to 4 gallons of water is used, but on delicate vegetation and for the destruction of plant lice, a solution of 1 pound to 6, or even 8, gallons is sufficient.

KEROSENE EMULSION. This kills more readily than the whale-oil soap solution, but unless prepared with care, so that all the kerosene is emulsified, there is some danger of its injuring vegetation. It cannot be purchased ready-made, but must be made from time to time as needed. It is more effective when whale-oil soap, instead of laundry soap, is used in its preparation. Following are the directions for making it:

Secure 2 pounds of whale oil (or good laundry) soap, 4 gallons of water and 8 gallons of kerosene. Weigh the soap carefully and place with the water in a vessel over the fire, using a slight excess of water to make up for evaporation. Fit a pump with a piece of hose, to which is attached a nozzle for throwing a straight stream 3-16 or ¼ of an inch in diameter. Pour the oil into a barrel or tub in which the pump is set, and when the soap is dissolved and the solution begins to boil, add it to the oil (*away from the fire*) and pump the whole vigorously back into itself for a period of at least 10 minutes. The stream from the nozzle should be directed straight down into the mixture so as to agitate it to the very bottom. After a few minutes the oil and soap solution will be seen to combine, forming a thick creamy solution, which, when perfectly made, will remain without change for several days. For a 20 per cent strength add water to make a total of 40 gallons; for a 15 per cent strength add water to make 54 gallons, and for a 10 per cent strength add water to make 80 gallons, and agitate thoroughly before use.

On tender vegetation and for destroying plant-lice a 10 per cent strength should be used. For the destruction of scale insects on dormant trees during winter a 15 or 20 per cent emulsion can be employed.

CRUDE PETROLEUM, known also as "crude oil," "Beaumont oil," "Jennings oil," etc., is the unrefined oil as it comes from the oil wells. It is sure death to all insects with which it comes in contact, but as it is also destructive to all vegetation its use for killing insects is confined to those cases where the insects can be sprayed with it when they are not upon vegetation or when they are upon vegetation which can be sacrificed in order to get rid of the pests.

It is useful for destroying colonies of the Argentine ant (which see, page 116), for killing army worms when they are congregated in large masses and for destroying Harlequin cabbage-bugs on trap plants in spring. Other possible uses will suggest themselves to the enterprising gardener. Its usual cost is about $1.50 per barrel.

LIME. Lime is useful for adding to mixtures of Paris green and London purple to prevent scorching of the foliage by the free arsenious acid (see the paragraphs treating of these poisons, pages 123-124). Lime is about the only efficient material for the destruction of garden snails, of which there are several kinds in Louisiana. If dry air-slaked lime be liberally scattered about the garden, or on the ground under plants, along fences, and in other places which are frequented by the snails, their death speedily results. The lime acts in an interesting way. When the snail comes in contact with the lime it attempts to excrete sufficient slime to carry away the lime, and by over-secretion its vitality is exhausted. Applications must be repeated frequently until the snails are brought well under control. Dry air-slaked lime is frequently used for driving undesirable insects, such as cucumber-beetles, from the garden. The operator walks with the wind, scattering the lime broadcast and driving the insects before him. It will also kill many soft-bodied insects with which it comes in contact.

BORDEAUX MIXTURE. This is the standard spraying remedy for mildews, "blights" and the various fungus diseases. It does not act as a poison when eaten by insects, and does not, by itself, prevent the work of very many injurious forms. Some pests, however, will not feed upon vegetation sprayed with it. This is notably the case with flea-beetles, which are difficult to kill with poisons, but which can be kept away from the plants by spraying them with Bordeaux mixture. When both a fungus disease and a biting insect are to be fought, poison can be combined with the Bordeaux mixture as indicated below, making one spraying serve for the destruction of both.

Bordeaux mixture is easily prepared from bluestone (copper sulphate), stone lime and water, although careful attention to details is necessary to insure a perfect combination. The strength of the mixture is generally indicated by a formula. For instance, the usual strength used is made from 4 pounds of copper sulphate, 6 pounds of stone lime, and 50 gallons of water, and is generally spoken of as the "4-6-50" formula. It will be noticed that the copper sulphate is named first, the lime next, and the water last. This rule is always observed. The "4-6-50" formula is adapted to use on hardy foliage, but where Bordeaux is used on trees or plants with tender foliage it is well to increase the amount of lime in proportion to the amount of bluestone, and use a "3-6-50" or even a "3-9-50' combination. For most plants the "3-6-50" Bordeaux meets all requirements.

The mixture is prepared as follows: Provide 3 barrels or large tubs and a kettle of boiling water. Weigh out 3 pounds of bluestone, tie it in burlap or some other porous cloth, leaving a string by which to swing the package. Take about 4 or 5 gallons of hot water, and "swish" the bluestone through it until it is entirely dissolved. This method insures much more complete solution of the bluestone than the ordinary one of simply dumping it into the water. When completely dissolved, add enough water to make 25 gallons.

Slack the 6 pounds of lime with a small quantity of *boiling hot water,* using, however, enough water to keep the lime from "scorching," and when thoroughly slaked make up to 25 gallons.

The solutions are now ready for final mixing, and should be kept thoroughly agitated. Two men should be employed in mixing the two solutions, and the lime and copper sulphate solutions should be poured into the third barrel simultaneously, so that the two streams will intermingle as they fall. This is best accomplished by taking a bucket of each solution and pouring them together into the barrel, holding them several feet above the top of the barrel. As the two streams fall a very pretty "precipitate" will be seen to form. Made by this method of mixing, it stays in suspension a longer time than when the mixture is prepared in any other way.

While spraying, the mixture should be kept constantly agitated, in order to insure an even distribution of the precipitate. If it is desired to combat some of the "chewing" insects, such as caterpillars, in addition to controlling a fungus disease, 1/4 pound of Paris green, or 2 pounds arsenate of lead (preferably the latter) may be added to each 50 gallons of Bordeaux. The Paris green or arsenate should be added after the mixture is made, and thoroughly stirred in, in order that it may be uniformly distributed throughout the mixture.

PYRETHRUM, "Persian insect powder," or "bubach." This is a fine powder, made from the dry flowers of certain daisies. It is not poisonous to mammals, but when brought into contact with insects destroys them by stopping up the spiracles or breathing pores. It is useful in dry form against household insects, such as fleas, and in the garden may be used for destroying insects upon vegetables nearly ready for harvesting, such as mature cabbages, tomatoes, etc. Best applied dry with a bellows or dust sprayer, it can also be used as a spray, at the rate of 1/2 ounce to 1 gallon of water. This product loses its strength when exposed to the air for any considerable time, hence will not do effective work unless secured fresh. Stocks kept for several years in drug stores are worthless for use by the gardener.

WATER. So common a substance as water is not without its uses in fighting insect pests. Thorough drenching of onion plants will largely stop the damage caused by thrips, and plant-lice can often be reduced in numbers by judicious and liberal use of the garden hose. Boiling hot water can be used to destroy colonies of ants which are exposed in the course of gardening operations, and water at a temperature of 135 to 140 degrees F. will destroy the cabbage-worms without injuring the cabbage heads. Hot or warm water cannot, however, be applied in the form of a spray, as the minute particles of the spray cool before reaching the plant.

FUMIGATING.

The gases used for fumigating have a rather limited use in the garden proper, but it not infrequently happens that the gardener has seed of various kinds which he wishes to preserve and protect against such insects as weevils, the drug-store beetle, etc. In this climate fumigation must be resorted to to-prevent entire destruction of such things as peas, corn and beans which are in storage. Two gases, hydrocyanic acid gas and the vapor of carbon bisulphide, are most useful for this purpose.

CARBON BISULPHIDE. Carbon bisulphide, or "high life," is a liquid formed by a chemical combination of carbon and sulphur. It changes to a gas very rapidly at ordinary temperatures and both the gas and the liquid are highly inflammable. The gas is heavier than air, therefore sinks to the bottom or floor of any room in which the liquid is opened or exposed. The gas, mixed in certain proportions with air, is highly explosive. The substance is no more dangerous to handle than is gasoline, and much the same precautions to prevent explosions or costly fires must be taken as with the latter substance. The seed or grain to be fumigated is placed in a tight bin or room and all openings closed as nearly air-tight as possible. The bisulphide is poured into shallow pans or trays, which are placed on top of the seed, or near the top of the room, and the compartment kept tightly closed for 24 hours. If the fumigation is performed in a bin, the top is covered during the process with heavy canvas, or, preferably, with a gas-tight cloth cover.[13]

When the fumigation is completed the room or bin is thoroughly aired out. No lanterns, lights or such things as pipes, cigars or cigarettes must be allowed near where the fumigation is going on.

Certain seeds, notably peas, have their germinating power impaired, or entirely destroyed, by exposure to the gas for too long or at too great a strength. For fumigation of peas, beans, etc., that are to be used for seed not over one pound of the bisulphide should be used to each 1,000 cubic feet of space contained in the bin or room. Peas, corn, etc., which are to be used as food can be fumigated with a much larger amount of the liquid. The bisulphide does not leave any taste or odor in foodstuffs and does not poison them.

HYDROCYANIC ACID GAS. This is the most deadly gas known. In practice it is generated from potassium cyanide, sulphuric acid and water. It is extremely dangerous to human life, a small amount of the gas causing death when inhaled. While the most effective agent known for the destruction of insects, its use is attended by such dangers that no one should attempt to use it except under the direct personal supervision of a trained entomologist.

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[13] Made by soaking heavy muslin in linseed oil and then drying.

WHERE SPRAYING APPARATUS AND INSECTICIDES MAY BE SECURED.

Many people are deterred from employing spraying machinery and insecticides at a time when their use would save valuable products because they do not know where these can be obtained. Unfortunately there are but few firms in Louisiana that handle either. There is no reason, however, why the truck grower should not secure these from the manufacturer as well as from his local merchant. They come from the manufacturer originally, and the customer must pay the transportation charges in the end anyhow. For the convenience of our correspondents we append herewith a list of the manufacturers of these commodities and the names and addresses of such Louisiana dealers as are known to handle either insecticides or spraying machinery.

Manufacturers of Spraying Machinery.

Goulds Manufacturing Co., Seneca Falls, N. Y.
Morrill & Morley, Benton Harbor, Mich.
F. E. Myers & Bro., Ashland Ohio.
Spramotor Co., Buffalo, N. Y.
Leggett & Bro., 301 Pearl St., New York.
"Friend" Manufacturing Co., Gasport, N. Y.
Niagara Sprayer Co., Middleport, N. Y.
R. H. Deyo & Co., Binghamton, N. Y.
E. C. Brown Co., Rochester, N. Y.

Manufacturers of Insecticides.

Grasselli Chemical Co., Cleveland, Ohio: Arsenate of lead.

Fred L. Lavanburg, 100 William St., New York: Paris green, lead arsenate, etc.

Schoonmaker & Son, Selkirk, N. Y.: Various insecticides.

Merrimac Chemical Co., 33 Broad St., Boston, Mass.: Arsenate of lead.

Bowker Insecticide Co., Cincinnati, Ohio: Arsenate of lead.

Frost Insecticide Co., Arlington, Mass.: Various insecticides.

James Good, 939-41 Front St., Philadelphia, Pa.: Whale-oil soap.

American Horticultural Distributing Co., Martinsburg, W. Va.: Arsenate of lead, etc.

Edward R. Taylor, Penn Yan, N. Y.: Carbon bisulphide.

E. H. Hunt, 76-78 Wabash Ave., Chicago, Ill.: Tobacco fumigating paper, tobacco solutions, etc.

Kentucky Tobacco Product Co., Louisville, Ky.: Tobacco fumigating paper, tobacco dust, etc.

Henry Heil Chemical Co., St. Louis, Mo.: Arsenate of lead, powdered lead arsenate, etc.

Merck & Co., St. Louis, Mo.: Cyanide of potash.

Hemingway & Co., 133 Front St., New York: Arsenate of lead, London purple, etc.

Louisiana Dealers in Spraying Machinery and Insecticides.[14]

Doherty Hardware Co., Baton Rouge: Spray pumps and dust sprayers.

Ahrens & Ott, New Orleans: Spray pumps.

Grasselli Chemical Co., Godchaux Bldg., New Orleans: Powdered arsenate of lead, sulphuric acid, etc.

J. Steckler Seed Co., 514 Gravier St., New Orleans: Lead arsenate, whale oil soap, etc.

Morris & Dickson Co., Shreveport: Cyanide of potash, sulphuric acid, Paris green, etc.

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[14] Paris green is obtainable from nearly all general merchants, and carbon bisulphide can be secured through any druggist.

Baton Rouge, La., July 19, 1909.

DIRECTIONS FOR SENDING INSECTS TO THE COMMISSION.

The Entomologist of the Commission is at all times glad to render (always free of charge) every assistance possible in determining the identity of insects and advising measures for their control.

Do not send insects in envelopes or pasteboard boxes by mail; they are inevitably crushed beyond recognition. Send living insects in strong *wooden* or *tin* boxes by mail. No openings are necessary to admit air. Whenever possible enclose some of the food-plant for the insects to subsist on while en route; specimens showing the injury done are desirable. *The name and address of sender should be on every package.* It is against the postal regulations to inclose a letter in a box by mail unless sent at letter postage rate. Specimens of caterpillars, worms, etc., *in alcohol or other liquid* can be sent by mail *only when in regular mailing tubes.* We will be greatly aided if correspondents writing about insect pests will give as full description of the habits, food-plants, injury and abundance as possible.

Specimens of twigs, living plants with foliage, etc., should be wrapped in damp (not wet) cotton cloth, so as to reach us in fresh condition. Fruits showing injury or disease should be wrapped well with paper and packed in a wooden or tin box.

Correspondents can materially aid the work of this office by communicating with us concerning their success or failure in using the methods advised for controlling injurious insects and diseases, giving a careful detailed account of the methods used and the results obtained. Such information will prove of value to all.

ANNOUNCEMENT.

A limited number of the following publications of the State Crop Pest Commission are still available for distribution and copies may be had upon application to the Commission at Baton Rouge:

Circular No. 4, December, 1905—"The San Jose Scale. Its Nature and Habits. How to Detect It and How to Control It." (42 pages.)

Circular No. 6, February, 1906—"A Preliminary Report on the Horseflies of Louisiana, with a Discussion of Remedies and Natural Enemies." (43 pages.)

Circular No. 8, May, 1906—"Report of the Executive Committee Upon the Paris Green Experiments Conducted Against the Boll Weevil During 1905." (31 pages.)

Circular No. 13, April, 1907—"Report Upon the Work of the State Crop Pest Commission." (11 pages.)

Circular No. 14, May, 1907—"A Simple Method of Eradicating the Cattle Tick by the Pasture Rotation Method." (4 pages.)

Circular No. 16, June, 1907—"The Most Important Factor in Solving the Boll Weevil Problem." (4 pages.)

Circular No. 17, July, 1907—"The State Crop Pest Commission in and Rules and Regulations of the State Crop Pest Commission in Effect July 1, 1907." (19 pages.)

Circular No. 18, July, 1907—"The White Fly and Its Treatment." (18 pages.)

Circular No. 19, August, 1907—"Protecting the Cotton Crop Against the Boll Worm." (4 pages.)

Circular No. 20, December, 1907—"The Insect Enemies of the Boll Weevil." (7 pages.)

Circular No. 21, January, 1908—"Report Upon Eradication of the Cattle Tick in Lincoln and Claiborne Parishes." (4 pages.)

Circular No. 22, May, 1908—"The Early Cotton and the Boll Weevil; How to Reduce the Number of Weevils During June and July." (7 pages.)

Circular No. 23, July, 1908—"Preliminary Report Upon Experiments with Powdered Arsenate of Lead as a Boll Weevil Poison." (40 pages.)

Circular No. 24, August, 1908—"Destroying the Boll Weevils Before They Enter Hibernation." (8 pages.)

Circular No. 25, January, 1909—"What Constitutes a Perfect Stand of Cotton When Fighting the Boll Weevil." (15 pages.)

Circular No. 26, February, 1909—"Report Upon Variety and Fertilizer Experiments With Cotton in the Boll Weevil Infested Sections of Louisiana." (22 pages.)

"Second Biennial Report of the Secretary for the years 1906-07." (27 pages.)

The Circulars, or bulletins, of the Commission are sent free of charge to all farmers who request them.

It is planned to issue a number of bulletins the coming fall and winter, containing the results of experimental work done in connection with the boll weevil and other pests. Much important new information will be contained in these bulletins.

Those who receive the present circular (No. 27) will know that their names are already on our mailing list and that they will receive future circulars. Others desiring forthcoming bulletins should, in order to guard against the editions being insufficient to meet the demand, see to it at once that their names are placed on the Commission's mailing list.

All communications should be addressed, not to individual members of the Commission's staff, but to the "State Crop Pest Commission, Baton Rouge, La."

YOU CANNOT EXPECT TO MAKE A FAIR COTTON CROP NEXT YEAR UNLESS YOU TAKE FULL ADVANTAGE OF THE IMPORTANT NEW INFORMATION CONTAINED IN THIS CIRCULAR!

STATE CROP PEST COMMISSION
OF LOUISIANA

CIRCULAR NO. 28. AUGUST, 1909.

The Circulars of the State Crop Pest Commission are sent free of charge to all farmers and fruit growers of Louisiana who make application therefor.

How to Increase the Death Rate Among the Boll Weevils During Winter so as to Protect the Following Year's Crop.

By WILMON NEWELL.

The State Crop Pest Commission has just completed a series of experiments at Mansura, Avoyelles Parish, in studying the hibernating habits of the boll weevil. The results of these experiments are really startling in their importance for they point the way to successful warfare against the weevil with unerring accuracy.

One of the objects of the experimental work at Mansura was to find out how many of the boll weevils could be gotten rid of by destroying the cotton plants at different times in the fall. To secure this information cages were made of wire cloth, each cage being 8x8 feet and 6 feet high. In these cages were placed piles of trash, leaves, moss, stumps, etc., to form winter quarters for the boll weevils such as they would find out-of-doors.

On September 28, 1908, a lot of live and active adult boll weevils were gathered in a near-by cotton field and placed in

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one of these cages and the cage securely locked. No growing cotton was in any of the cages. Thus these weevils were deprived of all food from then on. Had the cotton plants in the field been destroyed on September 28th the weevils there would likewise have been deprived of food. Therefore the number of weevils living through the winter in the cage must have been the same as the number living through the winter in the fields where the cotton plants were destroyed on September 28th. If anything, conditions would favor a slightly larger number surviving in the cage than in the field, for in the cage the weevils were protected from birds, mice, "punkies," etc. A cage of this kind was started once a week, from September 28 to December 21, 1908, with freshly collected weevils from the cotton field. The past spring (1909) the cages were watched every day and as the weevils came out of the trash they were counted, recorded, and then removed from the cages. In this way a complete record was obtained of the number of weevils living through the winter in each of the cages. Following are the results:

Out of 1,037 adult weevils collected in the fields on September 28, 1908, 28 lived through the winter. Of 1,195 gathered in the field on October 5th, 15 lived until spring. Of 1,132 weevils collected October 12th, 62 lived through the winter. Adding together these figures we see that out of the total of 3,364 weevils collected in the cotton fields between September 28th and October 12th only 105, or 3.1 per cent, succeeded in living through the winter. This simply meant that on the plantations **WHERE THE COTTON PLANTS WERE DESTROYED BEFORE OCTOBER 15, 1908, ONLY 3 PER CENT OF THE WEEVILS SURVIVED THE WINTER TO INFEST THE PRESENT YEAR'S CROP.**

On October 19th a cage was started containing 922 adult weevils and on October 26th a similar cage was started with 1,294 weevils. Out of the 2,216 boll weevils placed in these two cages 340, or 15.3 per cent, survived the winter. We may therefore safely conclude that on farms **WHERE THE COTTON PLANTS WERE DESTROYED BETWEEN OCTOBER 15th AND OCTOBER 27th, LAST FALL, AN AVERAGE OF ABOUT 15 PER CENT OF THE WEEVILS PASSED THROUGH THE WINTER SUCCESSFULLY.**

Additional cages were started in the same manner on November 2d, 9th, 16th and 23d, containing, respectively, 1,326, 1,326, 1,420 and 1,342 adult weevils. Out of this total of 5,414 weevils 1,181, or 21.8 per cent, succeeded in living until spring, showing that **WHERE THE COTTON PLANTS WERE DESTROYED BETWEEN NOVEMBER 1st AND 25th AN AVERAGE OF APPROXIMATELY 22 PER CENT OF THE WEEVILS SURVIVED THE WINTER.**

Cages started on November 30th and December 7th, containing a total of 743 weevils, showed a winter survival of 210 of them, or 28.3 per cent. Therefore **DESTRUCTION OF THE COTTON PLANTS AS LATE AS NOVEMBER 25th TO DECEMBER 7th RESULTED IN 28 PER CENT OF THE WEEVILS LIVING THROUGH THE WINTER.**

Out of 1,250 weevils collected in the fields on December 14th and 21st and placed in cages on those dates, 545, or 43.6 per cent, survived the winter. **POSTPONING FALL DESTRUCTION OF THE COTTON PLANTS UNTIL THE MIDDLE OF DECEMBER, OR LATER, PERMITTED OVER 43 PER CENT OF LAST SEASON'S BOLL WEEVILS TO SURVIVE THE WINTER AND ATTACK THE CROP OF 1909.**

These figures are so convincing that it is beyond comprehension that any farmer should continue trying to grow cotton without picking out his crop early and completely destroying the cotton plants—stalks, leaves, bolls and roots—long before the first autumn frost.

Destruction of the cotton plants before October 15th, in this instance, allowed but 3 per cent of the weevils to live until the crop of 1909 was subject to their attack. Against this small number of over-wintered weevils, as has been repeatedly proven by experience, the planter can make a good crop by the use of proper early-maturing varieties and by the adoption of the intensive cultural methods. By leaving the cotton plants standing until after the middle of December last fall the farmer invited certain destruction of this year's crop, for when he starts the spring with 43 per cent as many weevils as he had the previous fall he cannot hope to make a crop by any known means under the sun.

Arguments are still being made against early fall destruction of the cotton plants by those who steadfastly refuse to see the plain facts placed before them, but the farmers who *are* destroying the cotton plants early in the fall are making money growing cotton, and the fact remains, despite all arguments, that there is no other way in which a paying crop of cotton can be made under the conditions as they now exist in Louisiana and as they will exist for many years to come.

Strangely enough, there are farmers who still argue that they cannot pick out the crop early enough to destroy the cotton plants by October 15th or November 1st. The alternative is to have no cotton to pick out. Those who cannot so arrange their farm management as to follow our recommendation in this regard are simply advised not to grow cotton at all, for unless the weevils are destroyed—by destroying the cotton plants—*early* in the fall, a profitable crop is impossible.

DO NOT WAIT FOR SAD EXPERIENCE TO DRIVE THIS LESSON HOME TO YOU. IF YOU INTEND TO GROW COTTON NEXT YEAR MAKE ALL PREPARATIONS NOW TO PICK OUT THIS YEAR'S CROP AS FAST AS IT OPENS AND DESTROY ALL COTTON PLANTS BY CUTTING THEM DOWN AND BURNING THEM BEFORE OCTOBER 15th OR, AT THE LATEST, NOVEMBER 1st.

BATON ROUGE, LA.,
August 5, 1909.

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RALPH E. SMI

CIRCULAR NO. 29

OF THE

State Crop Pest Commission

OF

LOUISIANA

The Fumigation of Nursery Stock With Hydrocyanic Acid Gas

By Wilmon Newell

ISSUED UNDER THE DIRECTION OF THE

STATE BOARD OF AGRICULTURE AND IMMIGRATION.

CHAS. SCHULER, Commissioner.

Independent Printing Co.,
Baton Rouge, La.

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State Crop Pest Commission

OF LOUISIANA

CIRCULAR NO. 29 SEPTEMBER 1, 1909

The Circulars of the State Crop Pest Commission are sent free of charge to all farmers and fruit growers of Louisiana who make application therefor.

THE FUMIGATION OF NURSERY STOCK WITH HYDROCYANIC ACID GAS.

BY WILMON NEWELL.

With the development of the fruit growing industry of Louisiana there has been a marked increase in the number of nurseries and in the amount of nursery stock annually grown for sale in the State. At the same time there has been an increased demand for nursery stock grown in other States, most of which passes through the hands of Louisiana nurserymen before reaching the farmer or orchardist who finally plants it out. Most of the insects seriously injurious to fruit trees owe their dissemination to the shipment of nursery stock. Particularly is this true of San Jose scale, and as the demand for fruit trees has increased, the danger of this pest being distributed with them has also increased. The State Crop Pest Commission annually inspects all nurseries in the State and permits no stock to be sold if infestation by the San Jose scale can be detected. However, this insect is so small and elusive that no human eye can detect every scale or scan with precision every square inch of bark on hundreds of thousands of growing trees. Therefore additional precautions against the pest are necessary. In localities where San Jose scale occurs, or where the entomologist of the Commission finds the conditions surrounding a nursery such that there is danger of the stock becoming infested, fumigation of all trees is required before they are shipped from the nursery.*

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*Following is the regulation of the Crop Pest Commission relative to the fumigation of nursery stock in Louisiana:

"The Entomologist of the Commission shall have power to require any one in the State to fumigate his trees, shrubs or plants with hydrocyanic acid gas or other substance when, in his judgment, such treatment is necessary or advisable for the proper protection of the agricultural or horticultural interests of the State, or of any section thereof."

This fumigation is of course an added protection to the purchaser of the trees, in addition to the inspection.

The progressive nurseryman also finds it advisable, to prevent infestation of his own nursery, to fumigate all trees, stocks, cions etc., which he purchases from others.

Hydrocanic acid gas is the most deadly gas known and it is sure death to insects of all kinds. Likewise it is sure death to human beings and its use is not unattended by some danger. In spite of this fact it is the fumigant par excellence, not only for nursery stock, but for buildings, stores, mills, cars, etc., where undesirable insects or vermin are to be gotten rid of. In the hands of an experienced operator its use is comparatively safe, but one unfamiliar with its use and the attendant dangers should let it severely alone.

A number of the progressive nurserymen of Louisiana now have fumigating houses and annually fumigate their output of nursery stock. From the nurserymen and from other sources also we receive inquiries as to the method of using this gas for the destruction of insects. To meet these inquiries the present circular has been prepared. It deals entirely with the fumigation of nursery stock, but the same principles underly the fumigation of all buildings, the same strength of gas is ordinarily used and the necessary chemicals are handled in the same way. The present circular is, in substance, a paper published by the author as Bulletin No. 11 of the Georgia State Board of Entomology in 1904 and we are indebted to Prof. E. L. Worsham, State Entomologist of Georgia, for the loan of the cuts used herein.

The fumigation of nursery stock is not aimed at the San Jose scale alone, for it is equally efficacious in destroying the West Indian peach scale, the Putnam scale, Lecaniums, the woolly aphis and in short all insects which may be upon the trees when they are dug and packed for shipment to the customer.

It should not be understood, however, that fumigation will in all cases eradicate San Jose scale, but when the work is properly done it affords the best protection against this pest that has yet been devised. Impure chemicals, inaccurate scales, undetected leaks in the fumigating house or too close packing of the stock may defeat the object of fumigation, and since one can rarely be sure that his fumigating arrangements are working perfectly, it cannot be said that fumigation affords absolute protection. However, results of experiments conducted by this office show that infested trees can in many cases be entirely freed from scale by this process. The object of fumigating all nursery stock, after it has passed inspection, is to eradicate any slight case of infestation which might be overlooked by an inspector.

In this way two safe-guards are provided the orchardist who buys the stock against the introduction of scale into his orchard, whereas in the case of inspection alone, or of fumigation alone, but one safeguard is provided him.

The necessary equipment for fumigating nursery stock consists of an air-tight chamber (house or box), a glazed earthenware vessel, a glass measure graduated to ounces, and a set of accurate scales. The necessary chemicals are cyanide of potash (98 per cent) and sulphuric acid (specific gravity 1.83). Care should be taken to secure the 98 per cent or 99 per cent "C. P." cyanide,* otherwise an insufficient amount of the gas will be generated and the fumigation prove ineffective. As this substance deteriorates rapidly when exposed to the air, it should be kept in a tightly closed vessel. Its extremely poisonous properties should also be kept in mind and the material not left where it will fall into the hands of children or careless persons. The best grade of sulphuric acid only should be secured. The chemically pure acid is to be preferred. It will not do to employ the low-grade chamber acid, such as is used in the manufacture of fertilizer. The acid should be kept in glass or earthenware vessels, tightly stoppered.

FUMIGATING HOUSES.

The chief requisite for a fumigating house is that it shall be air-tight or gas-proof. It should also be of such shape that its cubic contents can be easily determined. The size of the house and the number of rooms contained must of course depend upon the amount of stock to be fumigated. In the case of small nurseries, either of the fumigating boxes described below will be found sufficient. In the case of very large nurseries a house with three, or even four, compartments—separated from each other by air-tight partitions—will be found economical, as the work of filling and emptying the rooms can be carried on simultaneously with the fumigation. The house should be on the packing grounds and the stock fumigated as it is dug and brought from the field. A house well adapted to the needs of the average nursery may be built as follows:

Two rooms are constructed, each 10x10 feet, inside measurement, 10½ feet high in front, and 7½ feet under the eaves, the roof sloping one way only. It is built directly upon the ground, with the sills sunk a few inches in the earth, and either with or without a floor. If on stiff clay, this when well packed, both inside and outside the sills, will answer for a floor. The walls, as well as the partition and roof (and floor, if clay is not used), should consist of a double course of sheathing or matched lumber with heavy building paper between. Care should be taken to have a smooth surface against which the paper is to fit, and the latter should be lapped one to two feet at all edges and at the corners.

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*Chemical analyses show that the "commercial" cyanide contains an average of 26.45 per cent of cyanide of potash, while the "U. S. P." or "C. P." article contains an average of 97.22 per cent.

Ordinary unmatched lumber may be used for the outside walls, the boards being fitted snugly together and three-inch strips nailed tightly over all cracks. The inner walls must be in all cases of "tongued and grooved" lumber, free from cracks and knot holes. After finishing, the interior should be given one or two heavy coatings of paint or white lead to fill all remaining small crevices. The outside of the house should also be painted if it is expected to be safe and serviceable for more than one season.

The roof, in addition to being made double, should be covered with tarred roofing paper. A door 3½x6½ feet, made double, refrigerator fashion, should be placed in the end or side of each room. The door should fit accurately, should be swung with three heavy hinges and when closed the edges should come snugly against a felt or rubber seat, thus making it air-tight. In order that the room may be quickly ventilated after fumigation, a window 2½x2½ or 3 feet should be placed at the top opposite the door. Like the latter, this should be made double and should close from the outside upon felt or rubber margins. The entire room, when the door is closed, should show no admission of light.

To permit of a more rapid and general diffusion of the gas a secondary floor should be constructed eight or ten inches above the ground or floor. This is merely a cheap frame-work of slats for supporting the stock, permitting the gas to circulate beneath it. The construction and plan of the house will be made clear by consulting Figure 1.

Where the amount of stock to be fumigated does not warrant the construction of a two-roomed house, a single-roomed house can be built upon the same plan. Such a house is shown in Figure 2. It can be constructed at a total cost for labor and materials of about $60.00.

Large nurseries usually construct houses of considerable capacity, some of these being large enough to fumigate several wagon loads of stock at one time. Wood is not the only material used for the construction of such houses. Brick, on account of its porous nature, does not make a gas-tight building and hence is not often used. Concrete, properly made and coated, makes a gas-tight house that can be used for years with little or no repairing. The walls of concrete fumigating houses should

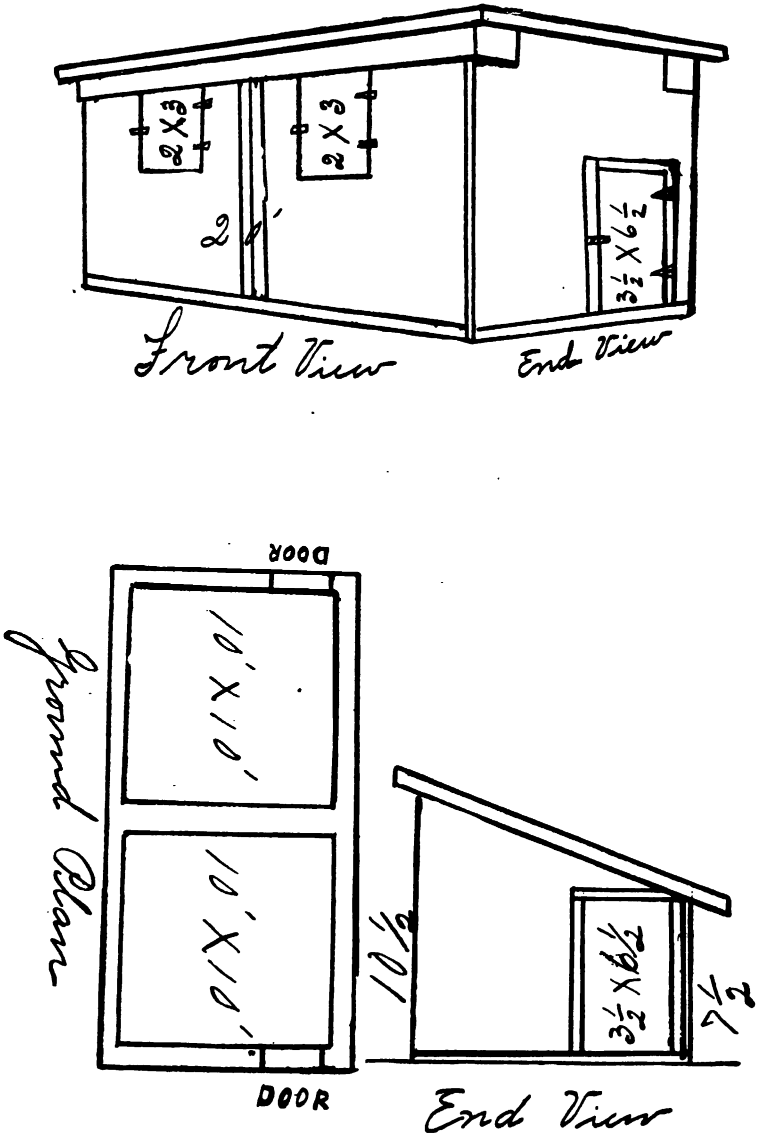

Fig. 1.—Plan of two-room wooden fumigating house. (Author's illustration, from Bulletin 11, Georgia State Board of Entomology.)

be thick, the inside should be heavily coated with varnish and the outside painted. These coatings are given to insure the wall being gas-tight. A concrete fumigating house, belonging to Smith Bros., of Concord, Ga., which has been in use for several years is shown in Figure 3. The house is 34 feet long and 14 feet wide; height to plates, 8 feet 8 inches. It is divided into four rooms, two of them being 12 feet by 13 feet 6 inches, and the other two being 3 feet by 5 feet 6 inches. The two large rooms are used for fumigating heavy nursery stock, while one of the smaller rooms is used for fumigating small lots of trees or for cions, cuttings, etc., that require small space. The other small room is used for storing chemicals.

Much time is saved by having two or more rooms in the fumigating house, as in the one shown in Figure 3, for then the stock in one room can be fumigated while the other room is being emptied of trees and being refilled.

COMPUTATION.

The standard formula for fumigating each 100 cubic feet of space contained in the fumigating house is as follows:

1 ounce potassium cyanide (98 or 99 per cent.)
2 fluid ounces sulphuric acid (sp. g. 1.83).
4 fluid ounces water.

The cubic contents of the house should be accurately determined and the amounts of cyanide, acid and water computed from the above formula. For example, the house described on page 141, containing 900 cubic feet, will require for each charge 9 ounces cyanide, 18 fluid ounces of acid, and 36 fluid ounces of water. The glazed earthware vessel should be somewhat larger than is necessary to hold the above amounts. A one or two-gallon jar is about the best container.

The above strength is used for one-year-old peach and for plum, apple, pear and hardy forest trees, all of which must be perfectly dormant. For June-budded peach, as well as for cions, buds, roses and tender plants, two thirds of above strength should be used, *i. e.*, 2-3 ounce of cyanide (with proportionate amounts of acid and water) per 100 cubic feet. For example, each room of the house shown in Figure 1, when fumigating June-budded peach, roses, etc., will require a charge of 6 ounces of cyanide, 12 ounces sulphuric acid, and 24 ounces of water.

Conifers and other evergreens should in no case be fumigated, as they are not known to be infested with San Jose scale and are perhaps more susceptible to injury than are deciduous trees and plants.

Strawberry plants can be effectually fumigated for killing the root-louse and perhaps certain other insects. However, it is very doubtful if they can be safely fumigated with hydrocyanic acid

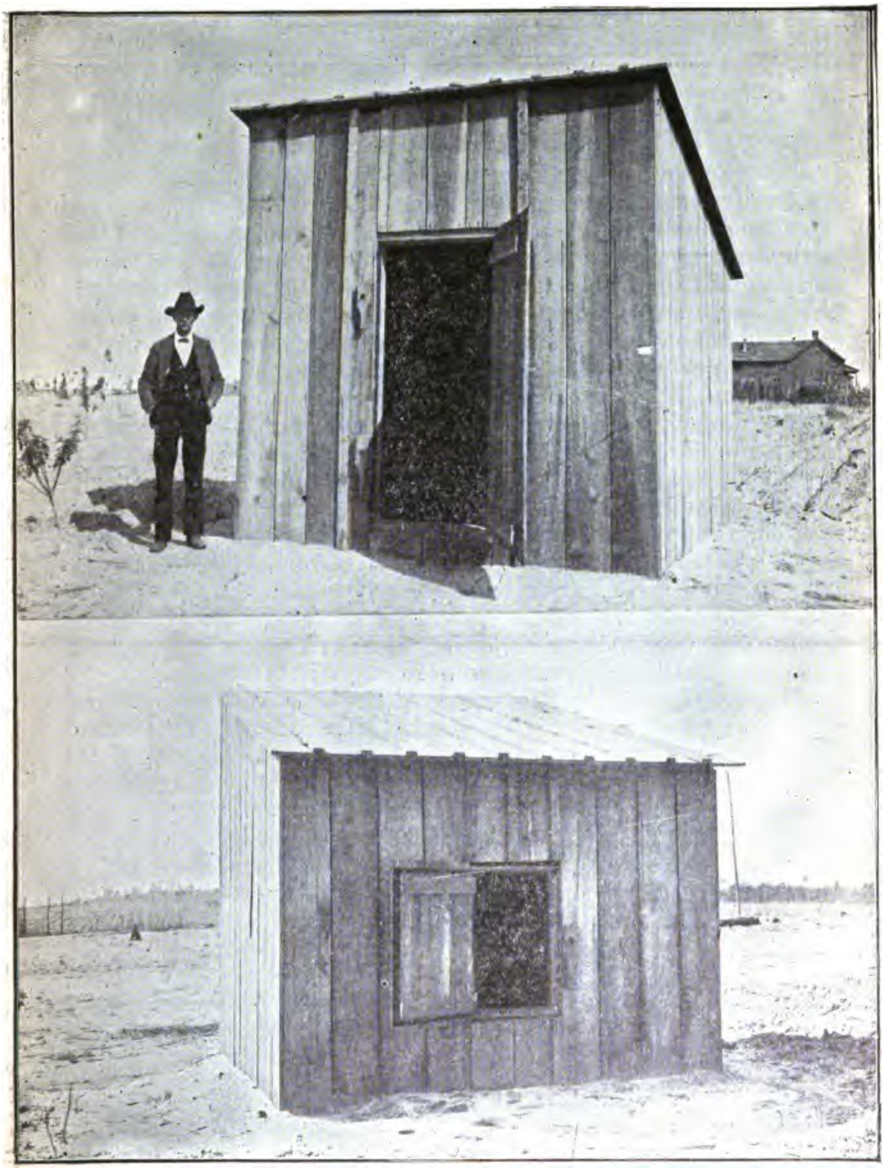

Fig. 2.—Front and rear views of one-room wooden fumigating house. (Author's illustration, from Bulletin 11, Georgia State Board of Entomology.)

gas which is strong enough to effectually dispose of San Jose scale. The Commission does not require the fumigation of strawberry plants. They are so easily and cheaply raised that there is no possible excuse for infested plants, or those in immediate danger of becoming infested, being placed on the market.

FUMIGATING THE NURSERY STOCK.

The trees as dug and brought from the field, should be placed in the fumigating house, care being taken to see that they are free from any considerable quantities of mud or dirt. Trees should not be fumigated when they are wet, as it has been shown that in this condition they are likely to be injured by the gas. No moss or other packing should be about the trees, nor should the bundles be too closely tied or packed. When the compartment is filled with stock, close the window securely and place the generating jar on the floor near the middle of the room. Pour into it the required amount of water and then slowly pour in the acid. The cyanide, previously weighed and enclosed in a tight paper bag, is now dropped into the jar and the door quickly and tightly closed. The steps in this operation should never be varied. If water is poured into the acid a violent action takes place and may be the cause of injury to the operator. Enclosing the cyanide in the paper bag makes it convenient and safe to handle and also retards the generation of the gas for a moment after being dropped, thus allowing time for the operator to leave the room and close the door securely.

The extremely poisonous nature of both the solid cyanide and the gas must always be borne in mind. The solid is best handled with forceps or wooden paddles as much as possible, and should never be handled by a person having open sores, cuts or bruises upon the hands, as the entrance of the poison into such may result seriously. The gas is colorless and if inhaled in quantity is fatal. Smaller amounts induce headache or dizziness.

After the generator has been started the room should be kept closed for forty minutes, at the end of which time the door and window should be thrown open, care being taken to avoid the outward rush of gas. After fifteen minutes of airing, the room may be safely entered and the stock removed, being now ready for packing or heeling in. After fumigation the contents of the jar should be buried.

FUMIGATING BOXES.

For fumigating nursery stock in small lots it is sometimes convenient to use a tight box of known capacity instead of a house. A box ten feet long, three feet four inches deep and three feet wide (inside measurement) is a convenient size for the small nursery. A box similar to the one described in Johnson's

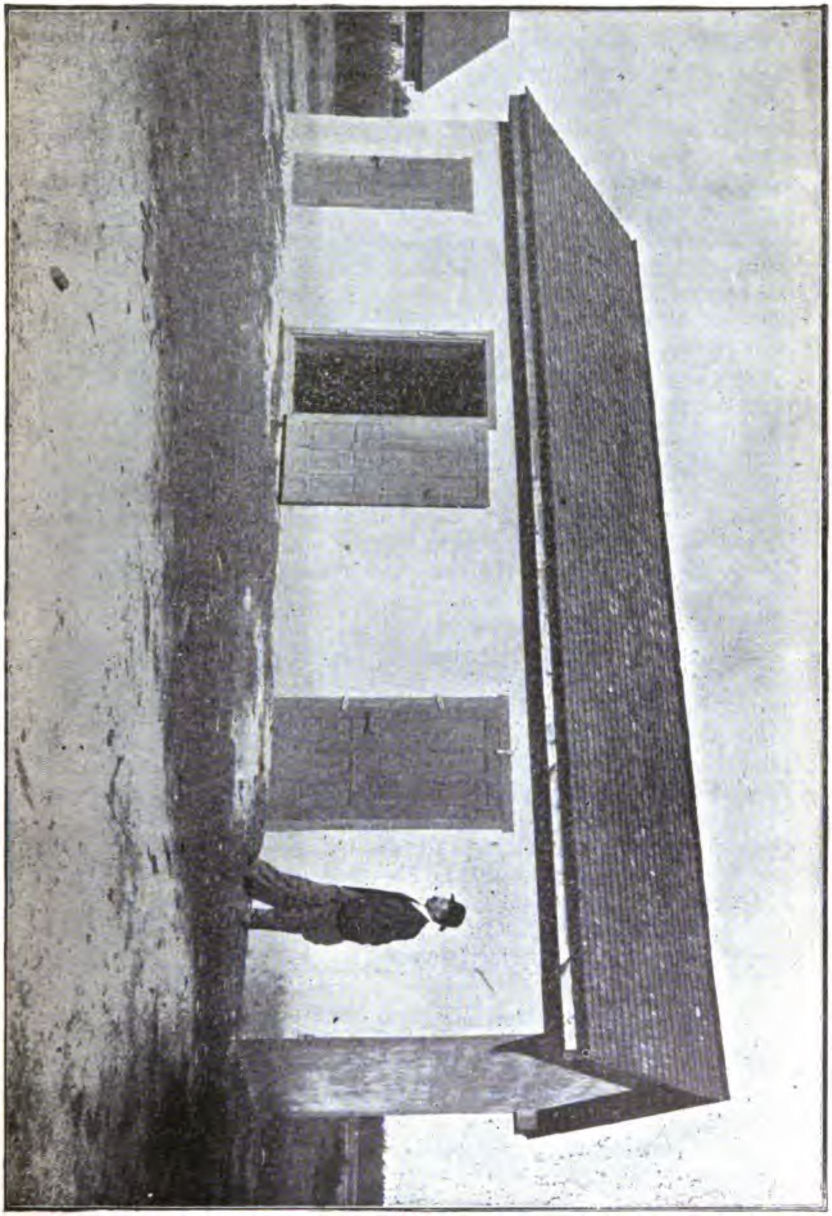

Fig. 3.—Three-room fumigating house, built of concrete. (Author's illustration, from Bulletin 11, Georgia State Board of Entomology.)

"Fumigation Methods," page 94, may be made as follows: (See Figure 4.)

Use plain matched three-quarter inch ceiling, making walls, top and bottom double, with heavy building or tarred paper between. Make the uprights of 2x6-inch stuff and reinforce the corners with 1¼x3-inch stuff and 2x3-inch battens. The upper edges of the box should be covered with felt, securely glued on so as to make an air-tight cushion-joint when the top is on. All parts of the box, including the cover, should be given a heavy coat of white lead. On each end of the box should be nailed two 2x6-inch beams with mortised ends projecting a few inches above the top for keying down the cover. A slat framework (removable) should be placed eight or nine inches above the floor to support the trees and to allow a better circulation of the gas.

On one side, about seven inches from the bottom and directly over the point where the vessel is to be placed, a 1½-inch auger-hole should be bored, slanting downward. Two funnels should be provided, one for the acid and water, and the other for the cyanide; also a tightly fittting plug to close the hole after the chemicals are in. A small door about 8x8 inches, double, swung on hinges and closing upon felt or rubber margins, is even preferable to the hole. With the door the cyanide can be placed in a paper bag and dropped into the acid and water mixture as indicated above for fumigating houses.

In operation the empty vessel is placed on the bottom of the box, just underneath the hole or door, the false bottom inserted and the box filled with nursery stock. The cover is then placed upon the box and two 2x8-inch timbers, eleven feet long, are placed lengthwise on the top with the ends inserted in the mortises of the uprights and keyed down tightly with wooden wedges. The required amounts of water, acid and cyanide are now poured through funnels into the dish in the order named, using one funnel for cyanide only. The hole is then tightly plugged. If a door is used the funnels are of course unnecessary.

For fumigating apple and pear stock, plums and peaches one year old, the charge is as follows:

1 ounce cyanide.
2 ounces sulphuric acid.
4 ounces water.

For fumigating June-budded stock and for roses, buds, and cions, the following charge should be used

2-3 ounce of cyanide.
1½ ounces of sulphuric acid.
3 ounces water.

In both cases the stock should be exposed to the gas for forty minutes.

A cheaper but less convenient box can be constructed the same as the box above mentioned, but lacking the cover, projecting uprights, felt edges and hole or door. In operation this box is filled with trees to within about ten or twelve inches of the top, the false bottom placed *on top* of the trees, securely fastened and the entire box inverted on level ground. One end of the box is now raised and supported by a block about a foot

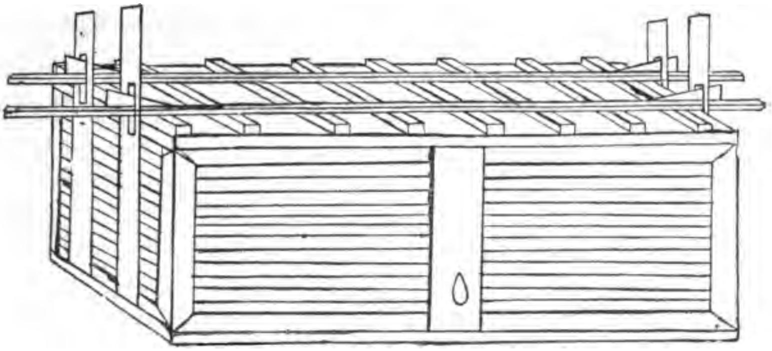

Fig. 4.—Fumigating box, with cover. (Author's illustration, from Bulletin 11, Georgia State Board of Entomology.)

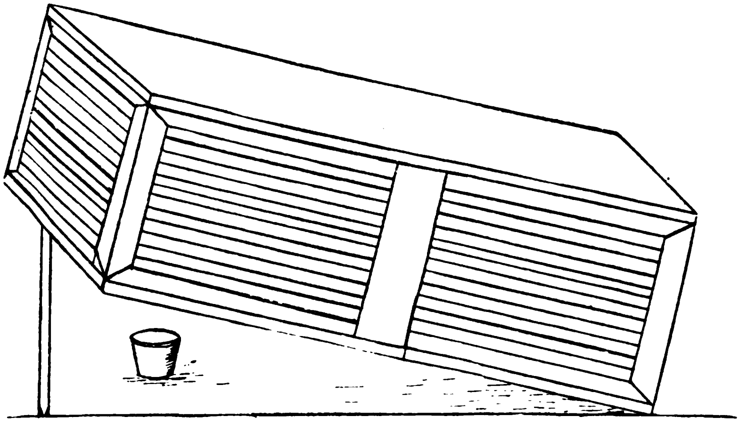

Fig. 5.—Fumigating box, without cover, showing generating jar ready to receive chemicals. (Author's illustration, from Bulletin 11, Georgia State Board of Entomology.)

long. The vessel containing the acid and water is placed beneath the box, the paper bag containing the cyanide is dropped in and the block knocked from under the edge (see Figure 5). Dirt is quickly piled around the edges of the box to stop all openings and then compacted with hoe or spade. At the expiration of the required forty minutes it is only necessary to turn over the box, allow it to air for a few minutes and then remove the stock.

The boxes above described, containing 100 cubic feet, are considered by some as a little too heavy for convenient handling. A box made upon the same plan, and having the same depth and width, but being only five feet in length, would contain just 50 cubic feet and the charge of chemicals therefor would be exactly one-half the charge given for the above boxes.

FUMIGATION OF BUDDING WOOD, CIONS, ETC.

Budding wood, cions, grafts, etc., can be safely fumigated before being used for propagation. Only in this way can the nurseryman guard with certainty against the introduction of San Jose scale into his nursery upon the buds or cions. For fumigating peach buds, etc., the weaker strength of the gas (*i. e.* 2-3 oz. cyanide—with proportionate amounts of acid and water—to each 100 cubic feet) should be used, but the time of exposure should be reduced to thirty minutes.

It is often convenient to use a comparatively small box for this purpose as usually only a small bundle will be fumigated at one time. Any small *air-tight* box may be used, and the amount of chemicals can be determined by multiplying the number of cubic feet contained in the box by two-tenths (.2). The resulting number will be the number of grams of cyanide required. For example, a box containing 19 cubic feet would require (19x.2) 3.8 grams of cyanide of potash, with proportionate amounts of sulphuric acid and water, which in this case would be 8 cubic centimeters of acid and 16 cubic centimeters of water. The writer will take pleasure in giving the exact formula for use in a box of any size upon receipt of its exact *inside* measurements.

When fumigating buds or grafts, as when fumigating other classes of nursery stock, it must be borne in mind that the *stock must not be wet*; that is, must not show visible moisture upon its surface.

RALPH E. SMITH

State Crop Pest Commission
OF LOUISIANA

CIRCULAR NO. 30 SEPTEMBER 15, 1909

The Circulars of the State Crop Pest Commission are sent free of charge to all farmers and fruit growers of Louisiana who make application therefor.

THE "V" COTTON STALK CUTTER.
HOW TO MAKE IT AND HOW TO USE IT.

By

WILMON NEWELL AND M. S. DOUGHERTY.

The effectiveness of early fall destruction of the cotton plants in destroying the boll weevils is no longer questioned. Not only has this step been endorsed by all the leading agricultural authorities in the South, but it has been approved and adopted by the successful cotton planters—those who are fighting the boll weevil successfully and making profitable crops of cotton in spite of the pest.

Many farmers, while admitting the wisdom of destroying the plants early in autumn, instead of postponing it until mid-winter, are deterred from doing so by the idea that it is an expensive operation and one likely to interfere with other important farm work. That this impression is entirely erroneous is shown by the fact that the planters, who go about it properly, cut down and burn the cotton plants at a cost of twenty-five to thirty-five cents per acre on uplands and from thirty-five to fifty cents per acre on alluvial lands.

By using a home-made stalk cutter such as the one herein described, from ten to fifteen acres per day can be cut down by one man and two horses. The cutter windrows the plants in every other middle, where they are allowed to dry, after which they are raked into piles with a pea vine rake and burned.

The "V-shaped cutter" has been in general use for several seasons in various sections of the State, and has proved itself to be a most effective and useful farm implement. For the convenience of those not familiar with its construction we have prepared specifications and drawings by which anybody handy with tools can make one in a short time. We have adopted the style of construction which, because of its rigiditiy and weight, has proven most satisfactory in operation.

THE STALK CUTTER.

The stalk cutter described below can be made in any plantation blacksmith shop, or on any farm where there are a few carpenter

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angle or elbow. These three holes are for receiving the three bolts (4-inch, 7-inch and 9-inch) which pass horizontally through the forward end of the machine.

In the 18-inch arm of this piece drill six holes (see *J*, figure 2) ½-inch in diameter, commencing at the end furthest from the elbow and placing them about 1½ inches apart.

Rudders (*ff*, figures 1 and 2).—Take each of the two iron pieces, ⅜ by 1½ by 24 inches, and bend it at right angles at a point 8 inches from one end, as described for bending the clevis attachment. Beat the outer edge thin, like a knife blade, so it will cut through the ground without unnecessary friction.

In the 16-inch arm of this rudder, beginning at a point four inches from the end, drill six holes about an inch apart. These holes permit the rudders to be raised or lowered according to the height of the rows in the field.

Blades (*hh*, figures 1 and 2).—These should be of good steel. They should be 6 or 7 feet in length and wide enough so they can be bolted firmly to the under sides of the 4 by 4 side pieces, the blades projecting out 1½ inches from the 4 by 4.

Old cross-cut saws make as good blades as can be secured. The smooth edge (*not* the toothed edge) of each is filed until it is as sharp as a razor. The necessary holes are also then drilled in it, so that it can be bolted firmly to the 4 by 4 side pieces of the frame.

Assembling the Parts.—Bolt the two side pieces (*aa*) to the base (*b*), and bolt the two forward ends of the side pieces together with the ⅜-inch bolts (4, 7 and 9 inches long), at the same time placing the clevis attachment between them and running the bolts through it as shown at *d* in figure 1. Added rigidity can be secured by running one or two more bolts, 9 to 11 inches long, through the front ends of the side pieces, back of the clevis iron.

Take the 3-foot piece of 2 by 6 cypress and bolt it on top of the frame, about 18 inches back of the front end, as shown at *C* in figure 1.

Next place the 5½-foot pieces of 4 by 4 inside the frame in the positions shown at *ee* (figures 1 and 2). Bevel their forward ends so they will fit snugly against the side pieces. Mortise the other ends of the 5½-foot pieces into the base *b*. Put bolts through the mortised portions and bolt the forward ends securely to both the 2 by 6 and to the 2 by 4 side pieces. These form the "rudder timbers."

About one foot in front of the base piece, make an opening through each rudder timber large enough to easily receive the 16-inch rudder arm, as shown at *ff* in the figures. Run one or two bolts through each rudder timber and its rudder.

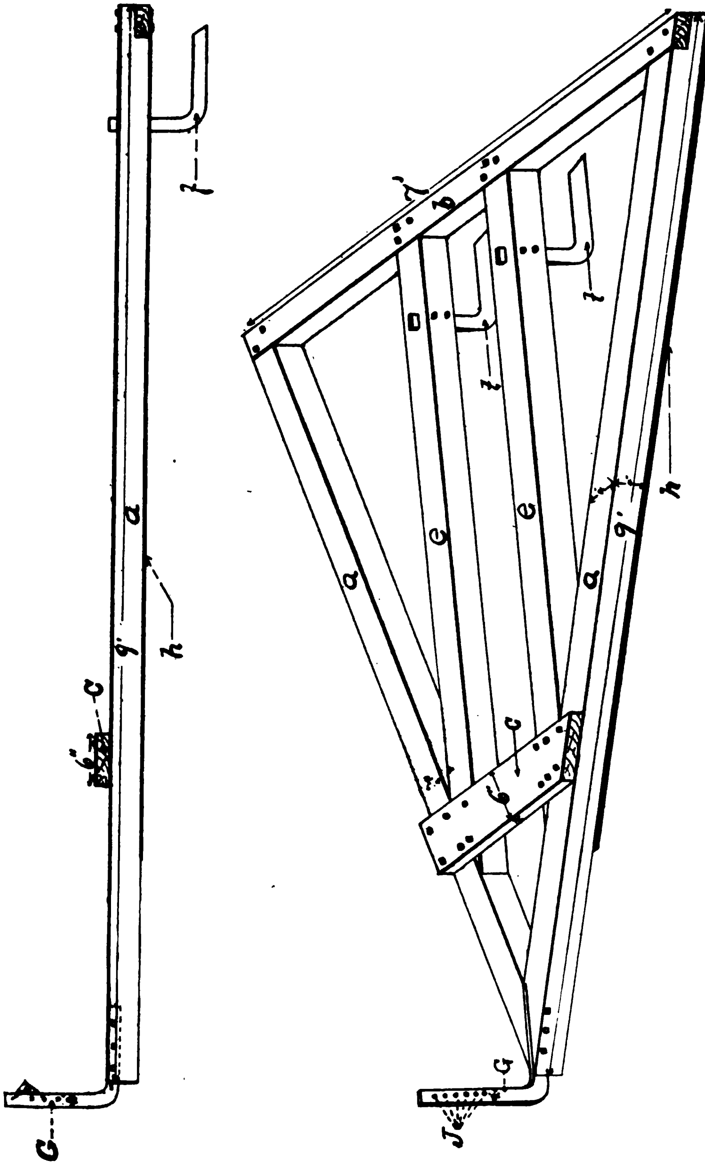

Fig. 2.—Side view and perspective view of stalk cutter, showing construction. (Original.)

The machine is now completed by bolting the blades securely to the under sides of the side pieces, the edges being allowed to project 1½ inches. These blades should extend well towards the rear corners, as shown at *hh*. If the blades are made from cross-cut saws the edges may happen to be slightly curved and in this case they should be set so they do not project more than 1¼ to 1½ inches at their centers. The blade (or saw) must be bolted *securely and tightly* to the frame. Use plenty of bolts.

These stalk cutters are sometimes constructed with only one rudder timber and one rudder (as the one shown in figure 3), instead of two, but such machines are rather light, and have a tendency to skid from side to side whenever they encounter skips in the row on either side. In a machine of this character the rudder is made in the same way but its arm must be longer, so it can be made to extend at least 11 inches below the frame.

The single rudder machine has its rudder running in the middle, where the ground is usually hard. Hence it does not go deep enough to hold the machine steady. The two-rudder machine, on the other hand, has its rudder running *in the sides of the rows* where the dirt is soft and where they enter deeply enough to effectually prevent all skidding.

USING THE CUTTER.

The cutter should be so adjusted that it will cut off the cotton stalks at the surface of the earth or just below. The depth to which the blades enter the earth is regulated by raising or lowering the chain by which the single-tree is attached to the front of the machine. If the single-tree is attached to the topmost hole in the clevis attachment the blades will run deep, and vice versa. The rudders should be set down far enough to prevent the machine skidding or jumping sideways. It is of the utmost importance that the blades be kept *very sharp.* To this end the operator should carry a good file and file the edges three or four times a day—oftener if need be.

Where there is no fence surrounding the cotton field it is best to hitch the two horses or mules tandem, one ahead of the other, as this permits both of them to walk in the middle and pull steadily. With the horses tandem, however, it is difficult to cut all stalks at the end of the rows if a fence is near and in such fields it is sometimes necessary to hitch the horses side by side, as shown in figure 3. If, for any reason, the machine does not sever *every* cotton plant *completely,* it is well to have a good hand follow the machine with a sharp cane knife and cut off every missed or partly severed plant at the surface of the ground. *It is extremely important that not a vestige of green cotton be left uncut in the field or at its edges.*

By reference to the illustration of Mr. Coco's stalk cutter (figure 3) it will be seen that the machine, as it cuts the plants, throws them into every other middle, thus windrowing them. After cutting they should be allowed to dry for one or two weeks, then raked together in piles ready for burning. An excellent implement for raking them into piles quickly and easily is the common pea vine rake (figure 4).

A dry day, with a stiff breeze blowing, should be selected for

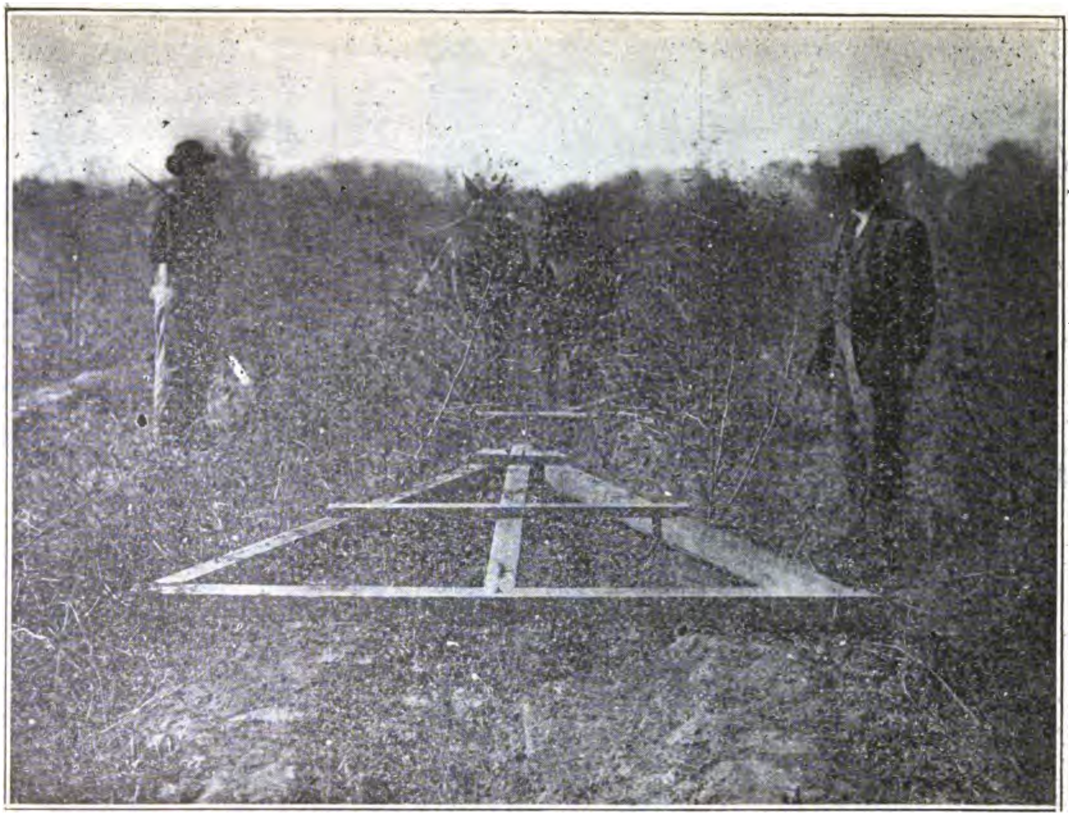

Fig. 3.—V stalk cutter in operation on the farm of Mr. Edward A. Coco. at Mansura, La. Notice how completely the plants are cut off and how the machine windrows them in every other middle. (Original.)

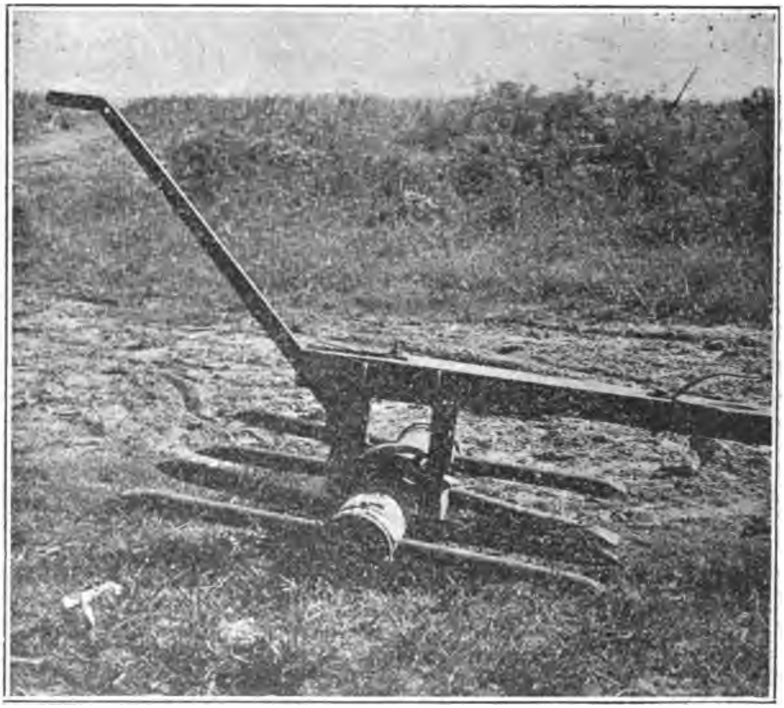

Fig. 4.—The pea vine rake—an excellent implement for raking the cotton plants into piles ready for burning. (Original.)

the burning and every pile of stalks burned up clean. The burning not only destroys all eggs and young boll weevil larvae in the squares and bolls, but it burns many adult weevils that gather on the partially dried green bolls to feed there.

With complete destruction of the cotton plants in the field the few weevils escaping the fire must either starve or betake themselves to the cotton fields of less progressive neighbors. There, if the cotton plants are not destroyed, they will feed until frost, then hibernate there, and be there next spring *to attack the neighbor's crop,* not yours. The farmer who does *not* destroy his cotton plants before frost will be the one to suffer.

Recent experiments at Mansura have more than ever emphasized the value of early fall destruction of the cotton plants. The information is contained in Circular No. 28 of the Crop Pest Commission, which will be sent (free) on request.

CIRCULAR NO. 31

OF THE

State Crop Pest Commission

OF

LOUISIANA

The Hibernation of the Boll Weevil in Central Louisiana

By Wilmon Newell and M. S. Dougherty

ISSUED UNDER THE DIRECTION OF THE
STATE BOARD OF AGRICULTURE AND IMMIGRATION.
CHAS. SCHULER, Commissioner.

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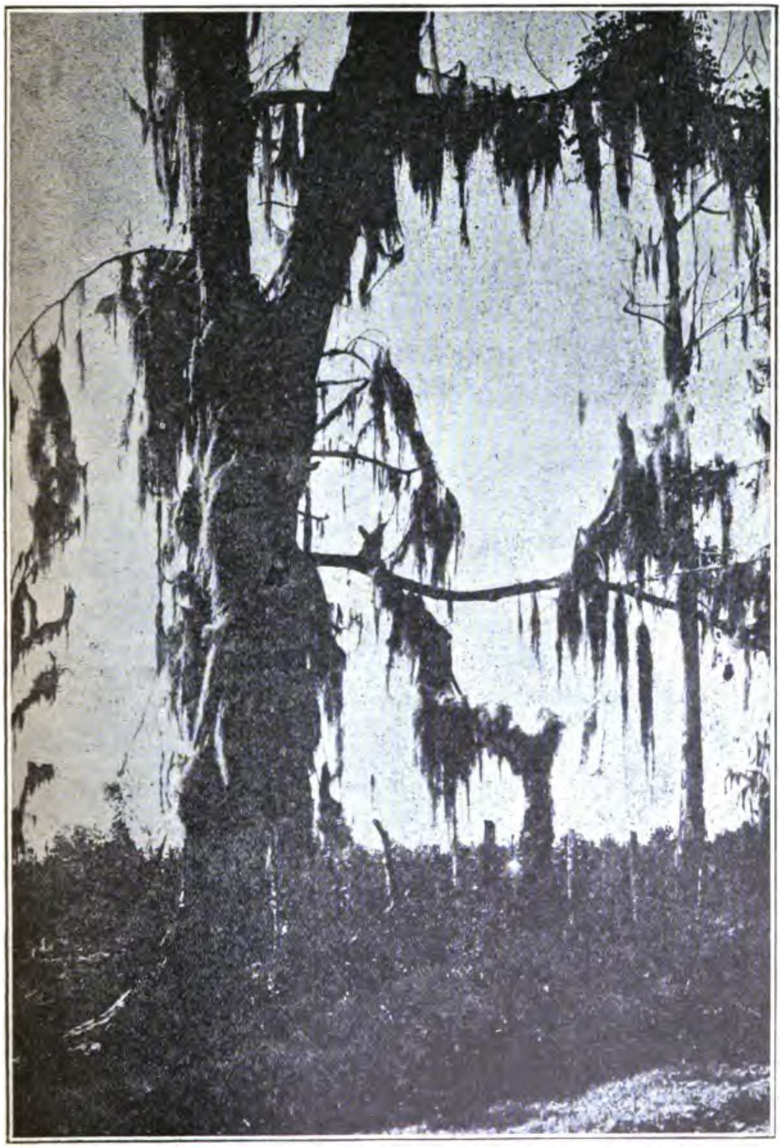

Fig. 1. Spanish moss on forest tree in Louisiana. In this moss the boll weevils find excellent winter protection. The weevils hibernating in the moss do not emerge from hibernation until very late in the spring. See page 201. (Original).

State Crop Pest Commission
OF LOUISIANA

CIRCULAR NO. 31 OCTOBER, 1909

The Circulars of the State Crop Pest Commission are sent free of charge to all farmers and fruit growers of Louisiana who make application therefor.

THE HIBERNATION OF THE BOLL WEEVIL IN CENTRAL LOUISIANA.

BY WILMON NEWELL AND M. S. DOUGHERTY.

Summary

Climatic conditions in Louisiana make the boll weevil problem a far more serious one than in Texas (p. 165.).

The habits of the boll weevil, as related to its hibernation, are of immense practical importance, as they furnish the clue to successful warfare against the pest (pp. 164-65).

Experiments, in large cages, were made at Mansura the past winter to find out what per cent of the boll weevils live through the winter, when they come out of winter quarters in the spring and how long they live after coming out of hibernation (pp. 164-69).

Every particle of the great mass of information secured in these experiments proves that early fall destruction of the cotton plants is the ONLY practical and successful way to kill the boll weevils. Cultural methods, without early fall destruction of the cotton plants, will not and cannot insure a cotton crop in Louisiana.

Out of 16,281 adult boll weevils confined in the 16 cages, 3,360, or 20.63 per cent lived through the winter successfully (p. 173).

Destruction of all cotton plants before October 15th resulted in only 3 per cent of the weevils surviving the winter (pp. 173-76).

Letting the cotton plants stand in the field until about Christmas resulted in over 40 per cent of the weevils living through the winter to attack the next crop (p. 176).

It was found that starvation of the boll weevils before they entered hibernation in fall was more effective in causing their death than was cold or wet weather during the winter (p. 171).

The average time that the weevils remained in hibernation was 159 days (p. 208). The extreme length of time that any weevil lived without food, while in hibernation, was 255 days, or 8½ months (p. 208). When the cotton plants are allowed to stand in the fields until killed by cold, the average weevil has to go without food for only about 94 days (p. 209). When cotton plants are destroyed before October 12th the average weevil must go over six months without food or starve to death. Early destruction of the cotton plants results in starvation of hordes of boll weevils (pp. 208-09).

Moss on the forest trees was found to shelter an enormous number of boll weevils during the winter (p. 168). Of the weevils that spent the winter in Spanish moss, 38 per cent lived through the winter. Of those hibernating in average materials only 20 per cent lived through (pp. 177-78). Boll weevils passing the winter in moss emerged from hibernation much later than those hibernating in other materials. Moss-covered trees near the cotton field increase weevil infestation. (pp. 209-10).

The length of time that the weevils live after leaving hibernation in spring has an important bearing on the problems of poisoning the weevil and of when to plant the crop to best advantage (pp. 210-11). The average over-wintering boll weevil lived 10.7 days after leaving winter quarters (p. 214). The maximum length of life, after leaving hibernation, was 44 days (p. 214).

INTRODUCTION.

Of the boll weevil's life history no phase is harder to study, and none is more important from a practical standpoint, than that of hibernation. Not only is it difficult to tell where the weevils are during the winter and the number that survives the winter season to attack the following crop, but it is equally difficult to gauge with accuracy the value of the various measures which may be adopted by the farmer to influence the number of weevils living through the winter. In order to secure accurate and practical information upon as many of these points as possible, the State Crop Pest Commission inaugurated a series of experiments, or rather observations, in the fall of 1908 at Mansura, Avoyelles Parish, near the geographical center of Louisiana.* The observations throughout were in the personal charge of the junior author, who gave them undivided attention from September 15, 1908, to July 15, 1909.†

The results of these experiments, from the standpoint of the Louisiana planter at least, are of far more practical importance than those of any like experiment previously made. Similar experiments have been made from time to time in Texas by Prof. W. D. Hunter, of the Bureau of Entomology, U. S. Department of Agriculture, but these have been under climatic conditions so different from those existing in Louisiana that the results form only an approximate basis upon which to formulate the most effective methods of warfare against the pest in this State. An experiment, very similar in some respects to the present one, was made by the Commission at Keachie, DeSoto Parish, in 1905-06. The conditions at Keachie, however, are far different from those existing in the central part of the State.

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*The elevation of Mansura above sea level is 73.3 feet. For this information we are indebted to Mr. H. B. Helm, Supt., La. Ry. & Nav. [illegible]

†The writers are under obligation to Mr. T. C. Barber for assistance rendered in the experiments from March until July, 1909, and to Mr. Edward A. Coco, of Mansura, our thanks are due for his generosity in donating the use of the land on which the cages were located. It was largely due to Mr. Coco's liberality and assistance in many ways that the experiments were made possible.

The results obtained in the Mansura hibernation experiments may be safely taken as indicative of the weevil's hibernating habits in most of the alluvial territory in the Mississippi, Red River, Black River, and Ouachita Valleys of Louisiana, because Mansura has practically the same prevailing temperatures, elevation and rainfall.

The practical value of a circular containing as much detail and as many tables as the present one may not at once appeal to the general reader. It should therefore be stated, by way of introduction, that these results show by actual figures the value derived by the farmer from destroying his cotton plants early in the fall, thereby reducing the number of weevils surviving the winter to attack the succeeding crop. Both the rate at which the weevils leave their hibernating quarters in spring and the length of time they live after leaving hibernation have a direct bearing upon the proper time for planting and upon the much discussed—and still unsolved—problem of poisoning the boll weevil with success and profit. In short, the key to successful warfare against the boll weevil is found in a critical study of the insect's hibernation and its life and habits as related thereto.

These experiments, showing as they do the enormous percentage of the weevils surviving the winter, emphasize the seriousness of the weevil situation in Louisiana as compared to the problem in Texas and they explain, as nothing else can, why the farmers of the central and southern portions of the State have found it impossible to make a paying crop of cotton in the face of weevil damages, by the adoption merely of early varieties and thorough cultivation.

In undertaking these experiments the writers sought light upon a number of features of the weevil problem, most of them of direct interest to the farmer, and all of them of immediate use in pursuing further studies of the pest. First of all it was desired to find out what percentage of the weevils survived the winter and, secondarily, when and at what rate they left their winter quarters in the spring to feed on the growing cotton. For this purpose a number of large wire screen cages, each 8x8 feet and 6 feet high, were constructed in a field near Mansura. Each cage was accurately made of straight pine 2x4s and 18-mesh galvanized wire screen. Each was provided with an insect-tight door, which in turn was provided with a strong Yale padlock to prevent interference from meddlers. In each cage was placed a pile of leaves, moss, corn stalks, grass and one or two large stumps to provide the weevils with average protection during the winter such as they could easily seek out-of-doors.

Adult weevils for the experiments were secured by paying negro children from 5 to 15 cents per hundred for gathering them alive in adjacent cotton fields and bringing them to the cages in glass jars and bottles, care being taken to prevent the weevils being saved up for more than 24 hours before their actual delivery.

The first cage was started on September 28, 1908, by placing a counted number of adult weevils in large glass jars and placing these upright in the cage. At the end of 24 hours the jars were removed from the cages and those weevils still in them, unable to crawl out, were counted and discarded, the number of weevils remaining in the cage being determined by difference. In this way those weevils which were injured in collecting or handling were entirely eliminated from the experiment, and in all cages only such weevils were used as possessed sufficient energy to either fly or crawl out of the large glass jars. A cage of this kind was started each week from September 28 to December 21, 1908, the weevils in each case being freshly gathered from the cotton fields when placed in the cages. This made a series of 13 cages, in all of which the hibernating quarters were as nearly alike as it was possible to make them. These cages, for convenience, were designated as the "regular series." The cages were located in a row in the open cotton field, on land above flood water, the row running north and south, and the cages sufficiently far apart so that they could not shade each other. By this arrangement all the cages received the same amount of sunshine, and all were, as nearly as possible, equally exposed to prevailing winds. This series of cages is shown in Figure 2. In the center of the row was placed a strong cage of poultry netting containing maximum and minimum thermometers and a self-recording thermograph and hygrograph so that a continuous secured during the entire time of the experiment. In addition to record of the temperature and humidity, day and night, was these instruments a self-recording rain gauge was installed and a record of the rainfall kept during the winter months and during the time of emergence of the weevils from hibernation. The number of weevils surviving the winter in each cage of the regular series will be found in Chapter II, and their rate of emergence from hibernation in Chapter III, Part 2.

As it was thought that the weevils might survive the winter in larger numbers if in the shelter of forest trees a cage, similar in

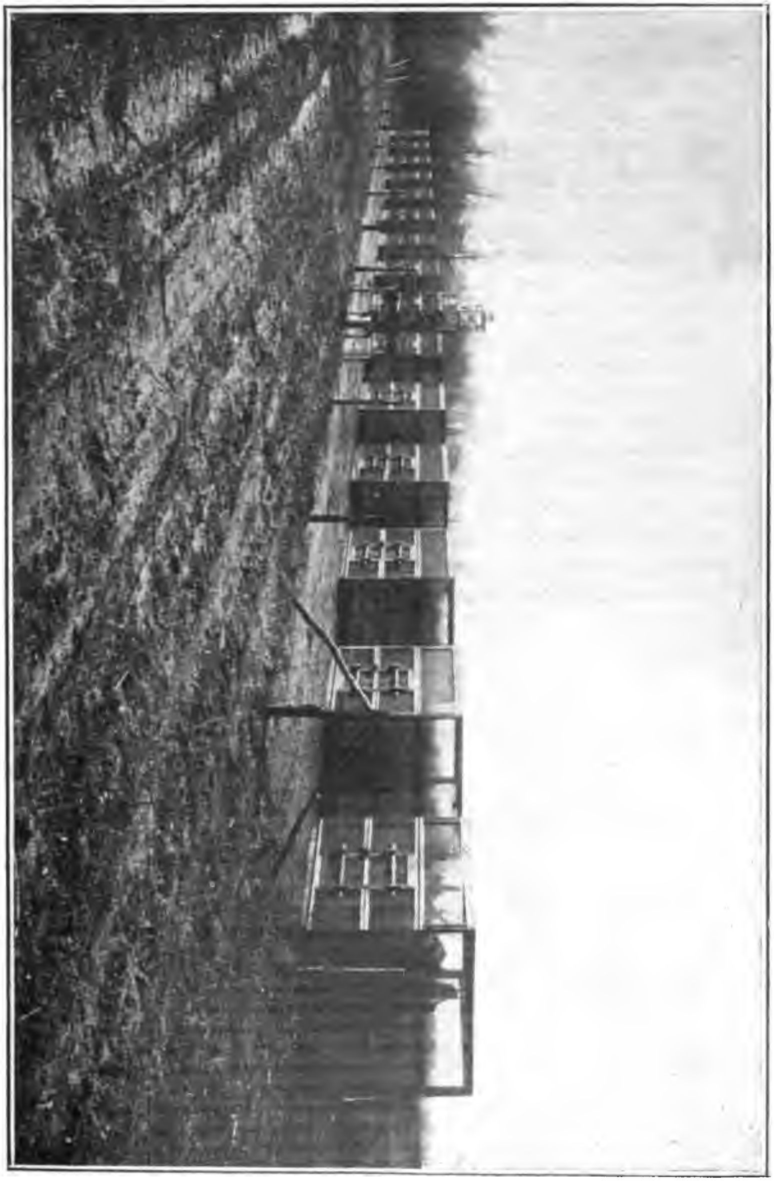

Fig 2. The large hibernation cages at Mansura, in which 16,281 boll weevils were confined for observation during the winter of 1908-09. (Original).

every respect to those in the regular series, was placed in an adjoining piece of low woodland or swamp. This cage was designated as No. 51 and was started upon the same date as Cage No. 5 in the regular series, both being inaugurated on October 26th.

The so-called "Spanish moss",* hanging upon the forest trees, has long since been recognized as offering a situation in which the weevils could find excellent winter protection.† To ascertain whether moss by itself offered better winter protection than a general assortment of materials a section of an elm tree, heavily laden with the moss, was cut in the forest and placed in a cage (designated as "A") near the regular series. The limb was green when cut, and after being placed in the cage was kept well watered so that the moss remained "green" and alive for a period of about two months. No other materials whatever were placed in this cage and the weevils were confined in it upon the same date as those confined in Cages 5 and 51. This cage therefore gave opportunity for comparing the winter survival of weevils in moss with the winter survival in other hibernating quarters. It also gave opportunity to observe whether the wee-

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Tillandsia usneoides.

†For the purpose of finding out to what extent the boll weevils hibernated in this moss, various lots were gathered in different situations around Mansura during the winter and examined for weevils. A large sack full of the moss was gathered in each situation, the moss weighed and the weevils found by pulling it apart. From the number of weevils found in a given weight of moss the number of weevils in a ton of the moss was estimated. Moss gathered six feet above the ground from the limb of an elm tree, standing in the edge of a cotton field, contained weevils at the rate of 2,415 to the ton. This examination was made December 15, 1908.

From an elm tree located in the swamp, one-fourth mile from the nearest field, moss was gathered from the limbs at a height of 15 feet. The ground in the swamp was covered with water and a dense growth of cane, 12 to 15 feet high, occurred all about the tree. In this moss was found 3,158 weevils to the ton. Date of examination, December 23, 1908.

On January 6, 1909, moss taken from a tree in the swamp, one-half mile from the nearest cotton field, was found to contain 678 weevils per ton. Moss taken from the same location on January 11 contained 1,100 to the ton.

Examination of moss from a tree one-fourth mile from a cotton field, January 27, 1909, revealed 552 weevils per ton.

Other examinations were made from time to time during the winter, the number of weevils varying between the extreme figures given above. It is significant that all the boll weevils found in the moss during the course of these examinations were alive; not a single dead one was found. This shows the remarkably good protection afforded the weevils by this material and the number of weevils found shows that they are not slow to take advantage of it.

In addition to the boll weevils, many other insects were found in the moss, prominent among them a closely related weevil, *Anthonomus suturalis*, and a lady-bird beetle, *Megilla maculata*, the latter in great abundance. Spiders of various kinds were also numerous.

vils hibernating in moss came out of winter quarters earlier in the spring than those which hibernated under average conditions. The former information will be found in Chapter II, and the latter in Chapter III, Part 3. Cage A was located in the open field and for comparison with it a similar cage, designated as Cage B, also containing a section of a tree laden with moss, was placed in a sheltered situation in the woods where it would be well shaded. Cage B, like Cage A, was started with weevils upon the same date as Cages 5 and 51. The nature of the surroundings of Cage 51 and Cage B can be gathered from Figure 3 A comparison of the number of weevils surviving the winter in Cages A and B will be found in Chapter II, on a subsequent page, and the dates at which they emerged from the moss in Chapter III, Part 4.

The cages of the regular series contained weevils gathered in the fields between September 28th and December 21st, all in average hibernating quarters. Those in Cages 51, A and B. were captured in the field at an intermediate date, October 26th, and while the cages containing the moss afforded extremely good winter protection for the weevils they did not present any more favorable conditions than were presented to the average weevils throughout Central Louisiana where plenty of moss is found near every cotton field. The average percentage of weevils surviving the winter in all these cages—those containing moss, those containing various materials, those sheltered in the woods, and those in the open field—should be very close to the actual percentage of weevils surviving the winter under all conditions in the fields and woods. We have thus considered it and the percentage of all weevils surviving the winter will be found in Chapter II. Their rate of emergence will be found recorded in Chapter III, Part 1.

CHAPTER I.

TIME OF ENTRANCE INTO HIBERNATION.

Messrs. Hunter and Hinds * of the Bureau of Entomology, U. S. Department of Agriculture, have considered that the majority of boll weevils seek hibernating quarters when the daily mean temperature falls to 60° or slightly below, but in our observations in Louisiana we have not found this to hold true. In the case of the hibernation experiments made at Keachie, La., 1905-6, we observed that none of the weevils manifested an inclination to

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*Bulletin 51, Bureau of Entomology, p. 103.

enter hibernation until December 8th, although the average daily mean temperature for ten days preceding this date was 43° and for five days preceding was 41.7°.*

From our observations the past season at Mansura, we are inclined to believe that it is the minimum temperature, rather than the mean, which most influences the time of entrance into hibernation. There is such a variation, however, in the time that individual weevils enter hibernation that no rule, so far as temperatures are concerned, can be detected as governing their actions in this regard. The first entrance of weevils into hibernation at Mansura in the fall of 1908 was on October 28th. The mean temperature for ten days (October 18 to 27, inclusive) preceding this date was 63.7°. The average daily minimum temperature during these ten days was 52.3° and the lowest daily minimum was 40°, but the minimum dropped from 46° on October 27th to 31° on October 28th, the day that the first weevils entered hibernation. This cool period lasted for five days, October 28th to November 1st, inclusive, during which time the daily minimums were 31°, 35°, 34°, 35° and 39°. During these five days the mean temperature was 52.5°. While a number of weevils entered hibernation during this cool period, far more of them entered hibernation during the second cool spell which commenced November 14th. At this time the minimum daily temperature dropped from 38° on the 13th to 31° on the 14th, and for the 15th, 16th, 17th and 18th was 24°, 26°, 26° and 34°, respectively. The mean temperature during this period of five days (November 14 to 18 inclusive) was 43.6°.

While the cool weather of October 28th to November 1st did very little injury to the cotton foliage, the freeze of November 14th to 18th practically killed it outright. This freeze was apparently more or less local in character, as cotton in many other localities was not killed until later.†

From the daily observations it appeared that when entering hibernation the weevils left the wire screen of the cages and entered the trash or moss during the warmest parts of the day, as during the nights and in the mornings and evenings the cold caused them to remain inactive.

All the weevils which entered hibernating quarters were very evidently in hibernation by the end of December. A few weevils were seen on the wire screen of the cages during the winter and during exceptionally warm spells their number was slightly increased. The most pronounced warm spell occurred during the latter part of January and more weevils were then visible in the cages than at any time during the winter. As the weather became cooler many of them disappeared and as no dead ones were seen on the ground in the cages it was supposed that they had returned to hibernation in the rubbish. We believe that a few of the weevils seen on the sides of the cages remained there throughout the entire winter. At various times small chalk marks were drawn around individual weevils and apparently the same weevils remained within them for a number of days in succession. The number of live weevils on the sides and tops of the cages on February 15th, when observations for emergence commenced, was 41.

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*Records of U. S. Weather Bureau Station at Shreveport, 23 miles northeast of Keachie.

†It is therefore likely that the number of weevils surviving the winter in these other localities was even greater than at Mansura.

In cages 1, 2, 3, and 4, in which the weevils were confined on September 28th, October 5th, October 12th and October 19th, respectively, the greatest death rate occurred during the comparatively warm weather prevailing between the date of their confinement and the time of their entrance into hibernation. This was evidenced by the large number of dead weevils seen within the cages. This fact is of the utmost importance to the cotton planter for it shows that the main cause of death among the weevils is not the prevalence of cold weather during winter, but **starvation prior to the time they enter hibernation. Obviously,** the only time they can be starved is before they enter hibernation, for after they become semi-dormant they cease feeding until the approach of warm weather. The early fall destruction of all cotton plants is the only way in which this starvation can be brought about.* This point was again strikingly illustrated by the number of weevils surviving the winter in Cages 5 and 6, as compared to the number surviving in Cages 1, 2, 3 and 4. In Cages 5 and 6 the weevils were confined on October 26th and November 2nd and they had but a short time to go without food before the weather became cool enough to induce hibernation, the first cool spell occurring on October 28th, and the first hard freeze on November 14th. In Cages 1, 2, 3 and 4 only 2.8 per cent of the weevils survived the winter, while the average survival in Cages 5 and 6 was 24.22 per cent.

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*The boll weevil has no other food plant than growing cotton, despite assertions to the contrary that are constantly being made by parties who are unable to distinguish the boll weevil from similar-looking insects. When starving, the boll weevils will EAT various things, usually to get the moisture contained in them, but careful experiments show that these substances do not prolong life any more than does pure water. These substances are therefore NOT FOOD.

CHAPTER II.

NUMBER OF ADULT BOLL WEEVILS SURVIVING THE WINTER.*

In discussing the number of weevils living through the winter it is necessary to decide what date shall be considered as terminating the "winter." As pointed out in the preceding Chapter adult weevils can be found in the cotton fields until in January, and exceptionally warm days in February may bring a limited number from their winter quarters and cause them to be active. The most severe winter weather is usually experienced in February, but during the latter part of February also the weather gradually becomes warmer and corn, as well as some cotton, is usually planted. We therefore decided that February 15th would be approximately the date which would mark the turning point from winter conditions unfavorable to the weevils, to the moderating and more favorable spring weather. Those weevils which survived until February 15th and after and succeeded in leaving the situations in which they spent the winter have been considered as living through the winter successfully.

It is not impossible that a very small number of the weevils succeed in living through the winter even though they do not find well-protected situations. Weevils were seen from time to time during the winter clinging to the inside of the wire cloth of the cages. Usually they were motionless and apparently dead, but there was no way in which it could be ascertained whether these same individual weevils remained there the entire winter or whether they appeared for a short time and then re-entered the trash in the cages (see page 171). Daily observations to determine the number of weevils leaving hibernation were commenced on February 15th. On this day the weather was cold and ice had to be broken from the padlocks in order to gain access to the cages. At this time there were a number of weevils sticking to the wire cloth, all apparently dead. In all of the 16 cages these amounted to 96. They were removed and when placed in a warm room 41 of them gradually resumed activity, the remaining 55 being dead. It is questionable whether these 41 weevils, out of the total 16,281 in the cages, should be looked upon as winter survivors, for the ice with which they were covered might have caused their death had they been left alone. Their removal from the cages at this time was necessary to prevent their confusing later observations. These 41 weevils are not included in the tables and statements below, and mention is here made of them only as a matter of interest. Even if they be considered as weevils which did not hibernate at all, they constituted but one-fourth of one per cent of the weevils confined in the cages.

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*Only boll weevils in the adult stage survive the winter in Louisiana. This conclusion is based upon examinations of cotton bolls and forms in various parts of the State during the past four winters. In the unopened bolls hanging on the plants boll weevil larvae and pupae are found until in January and even the early part of February but by March 1st they are invariably dead.

AVERAGE PERCENTAGE OF WEEVILS SURVIVING THE WINTER.

In the 13 cages of the regular series, started between September 28th and December 21st, there were confined 12,987 adult weevils. In the cage containing Spanish moss only, located in the open field, were 1,214 weevils; in the moss cage in the woods, 938. The remaining cage, containing a varied assortment of trash, leaves, etc., was located in the woods and contained 1,142 weevils. Out of this total number of 16,281 weevils, 3,360, or 20.63 per cent, lived through the winter and became active at various times during the spring and early summer. Inasmuch as the moss cages presented the extreme conditions favorable to the weevils and the early-started cages presented the most unfavorable conditions, the average survival of the weevils in all the cages should be a close index to the proportion of weevils surviving the winter under all conditions in the open fields and woods. This percentage appears exceedingly high, but a careful consideration of all factors likely to cause mortality among the weevils during winter brings us to the conclusion that the average survival in the cages must have been less, rather than more, than took place in the open. The rate at which these weevils left their winter quarters is given in Chapter III, Part I.

EFFECT OF FALL DESTRUCTION OF THE COTTON PLANTS ON THE NUMBER OF WEEVILS LIVING THROUGH THE WINTER.

Perhaps the most important information derived from the Mansura experiments was that secured from the 13 cages of the regular series, showing the effect of destroying the cotton plants, at different dates in fall, on the number of weevils surviving the winter. This has been treated of quite fully in Circular 28 of the Commission, which the reader is advised to secure and read carefully. As pointed out in Circular 28, collecting the weevils from the field and confining them in a large cage (in which there was no growing cotton) amounted to the same thing, so far as their food supply was concerned, as destroying the cotton plants in the field and leaving the weevils there to shift for themselves. When the weevils were collected and placed in the cages, they were taken away from their food supply. When the cotton plants were destroyed in the field the food supply was taken away from the weevils. As the weevils in the cages were provided with winter shelter such as all weevils out-of-doors could seek if they desired, the proportion surviving the winter in any given cage must have been approximately the same as the proportion surviving the winter in the fields where the stalks were destroyed upon the date these weevils were collected and confined in the cage. Each cage in the regular series therefore indicated the effect of fall destruction of the cotton plants upon the date that it was started. The following table gives the date upon which each cage in the regular series was started, the number of weevils confined in it and the number of them living through the winter successfully.

TABLE I.

WINTER SURVIVAL OF WEEVILS WHEN CONFINED IN CAGES AT DIFFERENT DATES IN THE FALL OF 1908.

Cage No.	Date weevils were confined in cage.	Number of weevils confined in cage.	Number surviving the winter.	Per cent.
1	Sept. 28	1037	28	2.7
2	Oct. 5	1195	15	1.26
3	Oct. 12	1132	62	5.48
4	Oct. 19	922	15	1.63
5	Oct. 26	1294	325	25.12
6	Nov. 2	1326	309	23.3
7	Nov. 9	1326	323	24.36
8	Nov. 16	1420	379	26.69
9	Nov. 23	1342	170	12.67
10	Nov. 30	569	169	29.7
11	Dec. 7	174	41	23.56
12	Dec. 14	767	366	47.72
13	Dec. 21	483	179	37.06

A hasty glance at the above table is sufficient to show that, in general, the later the weevils were gathered in the field and confined in the cages, the more survived the winter. Correspondingly, the later the weevils were deprived of food in the fields by destruction of the cotton plants, the greater must have been the proportion of them living through the winter. If this be true the reader may ask why Cage 2, started on October 2nd, for example, showed a smaller winter survival of the weevils than did Cage 1, started on September 28th. To this our only reply is that we are not fixing figures to theories: we are merely giving the facts as we found them. However, it is hardly possible that one could collect different lots of weevils in the open field and have all of them of exactly the same age and vitality. These factors would of course affect the length of life of the weevils and would influence their ability to withstand the unfavorable conditions of winter. In the case of the difference existing between the percentage (37) surviving in Cage 13 and that (47.7) in Cage 12 a very logical explanation does present itself. By December 21st, when the weevils for Cage 13 were collected, all cotton plants were dead and the living weevils found in the field were sluggish and barely active. It is likely that the youngest and most vigorous weevils had left the fields and sought favorable hibernating quarters before that time, hence the weevils collected at this late date were in all probability old and feeble ones which possessed insufficient energy to seek suitable winter quarters. This would easily account for the smaller number of the ''December 21st weevils'' surviving the winter. These slight discrepancies in the results, as compared to what would be expected on purely theoretical grounds, do not in the least minimize the importance of the information secured.

The true significence of the figures given in Table I can be arrived at by considering the cages in groups, thereby securing an average of the survivals when the weevils were collected early in the fall, at an intermediate date and late in the fall. Thus, if we consider Cages 1, 2 and 3 together, we see that they contained a total of 3364 weevils gathered from the cotton fields between September 28th and October 12th, and that out of this number only 105, or 3.1 per cent, survived the winter. In the same manner, by considering Cages 4 and 5 together, the two containing 2216 boll weevils collected between October 19th and 26th, we see that 340, or 15.3 per cent, lived through the winter. Cages 6, 7, 8 and 9, containing 5414 weevils collected during November, showed a winter survival of 1181, or 21.8 per cent. This increasing survival of the weevils, the later they were collected, is still further emphasized by considering the outcome in Cages 10 and 11, containing 743 weevils, out of which number 210, or 28.3 per cent, successfully survived the winter. Lastly, the almost incredibly high percentage of 43.6 is seen to have survived the winter in Cages 12 and 13, where 545 weevils out of 1250, lived through the winter. From these figures, we may safely draw the following conclusions as to the benefits—or lack of them—derived from the destruction of the cotton plants at different dates in the fall of 1908:

1. On plantations where the cotton plants were destroyed before October 15, 1908, only 3 per cent of the weevils survived the winter to infest the present year's crop.
2. Where the cotton plants were completely destroyed between October 15th and October 27th, last fall, an average of about 15 per cent of the weevils passed through the winter successfully.
3. Where the cotton plants were destroyed between November 1st and 25th an average of approximately 22 per cent of the weevils survived the winter.
4. Destruction of the cotton plants as late as November 30th to December 7th resulted in 28 per cent of the boll weevils living through the winter.
5. Postponing fall destruction of the cotton plants until the middle of December, or later, permitted over 43 per cent of last season's boll weevils to survive the winter and attack the crop of 1909.

The above results are really far more significant than the percentages indicate. The 3 per cent which survived the winter in the case of Cages 1, 2 and 3 was three per cent of the weevils present in the fields *in late September and early October,* while the 43 per cent surviving in Cages 12 and 13 represented 43 per cent of the weevils present in the fields *in December.* Weevils are normally far more abundant during December than during the lattter part of summer, two months longer having been afforded them in which to breed and increase.

These results offer the simplest possible explanation of why those farmers who destroy their cotton plants early in the fall make good crops of cotton, while those who do not do so make no crop at all—except when Providence intercedes in their behalf—no matter what varieties they use or how industriously they cultivate the crop. Destruction of the cotton plants before October 15th, in this instance, allowed but 3 per cent of the weevils to live until the crop of 1909 was subject to their attack. Against this small number of over-wintered weevils, as has been repeatedly proven by experience, the planter can make a good crop by the use of quick-maturing varieties and by intensive cultivation. On the other hand the planter, by leaving his cotton plants standing until after the middle of last December, invited certain destruction of the 1909 crop, for when starting the spring with 43 per cent of the previous year's weevils he cannot hope to make a paying crop by any known method. Were the planters to devote one-half as much enthusiasm and energy to the early harvesting of the crop and to the early destruction of the cotton plants as they now do to thorough cultivation of the growing crop, they would not only make more cotton but would make it at a less cost per pound than at present.

WINTER SURVIVAL OF BOLL WEEVILS IN SPANISH MOSS AS COMPARED TO SURVIVAL IN AVERAGE HIBERNATING QUARTERS.

Attention to the fact that Spanish moss offers favorable protection for the boll weevils during winter was first called by Prof. W. D. Hunter, of the Bureau of Entomology, U. S. Dept. of Agriculture. Owing to the great abundance of this moss on the trees in most parts of Louisiana, and particularly in the alluvial lands of Central Louisiana, it was decided to find out to what extent this material assisted the weevils in surviving the winter.

On October 26, the date on which the fifth cage of the regular series was started, another cage was also started near it in the open field, containing a limb loaded with Spanish moss. This cage was designated as Cage A. On the same date a similar "moss cage" was started in the shelter of trees in a piece of swamp land about fifty yards distant. This latter cage was designated as B. A fourth cage, known as No. 51, was also started on October 26th. No. 51 contained exactly the same sort of hibernating material as Cage 5, but like Cage B, was located in the swamp. This made one moss cage in the field comparable with a similar one in the swamp; also one of average conditions in the open field comparable with a like one in the swamp, the four being started on the same day. The comparative number of weevils surviving in these cages is given in the following table:

TABLE II.

COMPARATIVE WINTER SURVIVAL OF WEEVILS IN SPANISH MOSS AND IN AVERAGE HIBERNATING QUARTERS.

Cage No.	Date started.	Weevils contained.	Weeevils surviving the winter.	Hibernating quarters in cage.	Per cent.
5	Oct. 26	1294	325	"Average"	25.12 Clear
51	Oct. 26	1142	162	(leaves, grass, stumps, etc.)	14.19 Swamp
Totals........		2436	487		

Per cent surviving in average winter quarters........ 20.00

TABLE II.—(Continued.)

Cage No.	Date started.	Weevils contained.	Weevils surviving the winter.	Hibernating quarters in cage.	Per cent.	
A	Oct. 26	1214	409	Spanish moss	33.69	Open
B	Oct. 26	938	408	Spanish moss	43.49	Swamp
Totals........		2152	817			

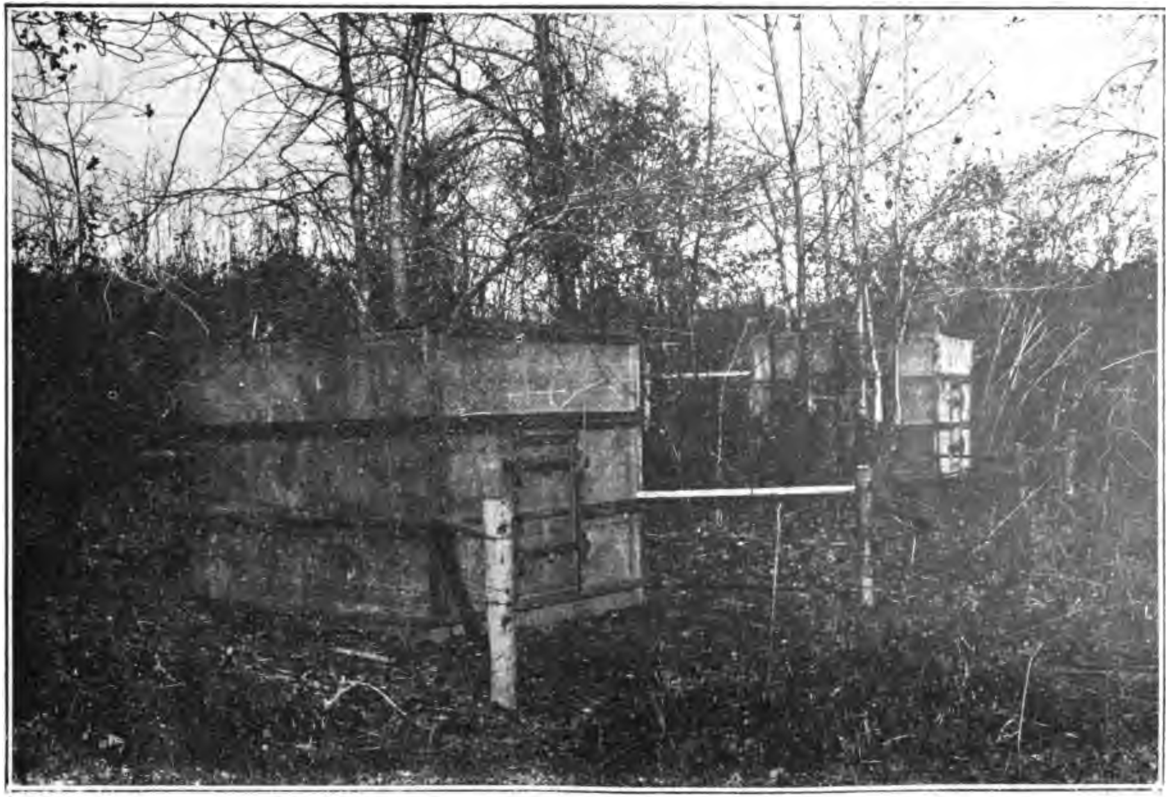
Per cent surviving in Spanish moss.................. 37.96

In the fact that 38 per cent of the weevils hibernating in the Spanish moss survived the winter, whereas but 20 per cent survived where the general hibernating quarters were supplied, is found one of the reasons why the boll weevil problem is a much more serious and complicated one in Louisiana than in Texas. That the weevils do seek the Spanish moss and hibernate there in enormous numbers is attested by the examinations which were made of Spanish moss at Mansura during the past winter, the results of which are given in the footnote on page 168.

The time and rate at which the weevils hibernating in moss emerged therefrom, as compared with the emergence of those hibernating in other materials, are presented in Chapter III. Part 3.

COMPARATIVE NUMBER OF WEEVILS LIVING THROUGH THE WINTER WHEN HIBERNATING IN THE WOODS, AS COMPARED TO THOSE HIBERNATING IN UNPROTECTED SITUATIONS.

To arrive at this information it is only necessary to compare, in a different way, the results obtained in Cages 5, 51, A and B. As just explained, Cages 5 and A were located in the open field and Cages 51 and B were located in the swamp as shown in Figure 3. Out of the 1294 weevils in Cage 5, 325 survived the winter and out of 1214 weevils in Cage A, 409 survived. This gave a total of 734 surviving the winter out of 2508 hibernating in the cages in the open field, or 28.46 per cent. 938 weevils were contained in Cage B and 1142 in Cage 51. Out of the 2080 weevils in these cages in the swamp 570, or 27.4 per cent, survived the winter. These percentages are so close that it would appear as though it makes little difference in the mortality among the weevils whether they hibernate in the woods or in the fields, just so they secure good protection in trash or moss.



Fig· 3. Hibernation cages in the woods at Mansura. Boll weevils were confined in these cages to find out whether more of them would live through the winter in the woods than in the open field. See page 178 (Original).

WEATHER CONDITIONS PREVAILING DURING THE HIBERNATING PERIOD.

The factors which most largely determine the mortality among the boll weevils after they enter hibernation are temperature, time and amount of rainfall, and the nature of the hibernating quarters available in any given locality. What effect a pronounced difference in rainfall or temperature during the winter months has in causing a larger or smaller number of weevils to survive the winter can be determined only after the experiment at Mansura has been repeated and comparative data secured on the winter survival for seasons of different characters.

The temperature and humidity at Mansura from September 28th, the beginning of the experiment, to February 20th are given in the table below and from the records of winter survival already given one may form a very adequate idea of the number of weevils likely to survive the winter in seasons having approximately the same temperature and rainfall.

The records of temperature were made by a standard self-recording thermograph which was periodically checked by a standardized mercurial thermometer and a set of government pattern maximum and minimum recording thermometers. The record of humidity was made by a self-recording hygrograph which was kept in adjustment and verified by frequent readings of the sling psychrometer. The record of rainfall was made by a self-recording rain gauge, located on top of the middle cage, which recorded all rains amounting to one one-hundredth of an inch or more. In the table the rainfall is given by weekly periods. In short, all the records of meteorological conditions were made by instruments as accurate and delicate as money could purchase and they may be counted on as being even more exact than the records made by the U. S. Weather Bureau at its various voluntary observing stations throughout the State.

TABLE III.

TEMPERATURE AND HUMIDITY AT MANSURA, LA., FROM SEPT. 28, 1908, TO FEBRUARY 20, 1909, INCLUSIVE.†

Date.	Temperature, degrees F.			Humidity, per cent.		
	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.
Sept. 28	85	57	71	97	35	66
Sept. 29	74	44	59	93	39	66
Sept. 30	81	44	62.5	97	35	66
Oct. 1	83	46	64.5	97	43	70
Oct. 2	77	46	61.5	92	35	63.5
Oct. 3	85	43	64	99	33	66
Oct. 4	86	53	69.5	98	44	71
Oct. 5	82	44	63	94	41	67.5
Oct. 6	84	49	66.5	99	42	70.5
Oct. 7	83	58	70.5	95	47	71
Oct. 8	73	56	64.5	96	39	67.5
Oct. 9	69	46	57.5	89	35	62
Oct. 10	74	39	56.5	100	30	65
Oct. 11	78	40	59	100	30	65
Oct. 12	76	45	60.5	91	37	64
Oct. 13	83	40	61.5	100	29	64.5
Oct. 14	84	46	65	90	30	60
Oct. 15	85	49	67	89	25	57
Oct. 16	86	47	66.5	89	28	58.5
Oct. 17	77	64	70.5	86	52	69
Oct. 18	87	70	78.5	85	40	62.5
Oct. 19	86	58	72	89	43	66
Oct. 20	86	55	70.5	100	39	69.5
Oct. 21	87	58	72.5	99	45	72
Oct. 22	80	60	70	100	55	77.5
Oct. 23	73	53	63	99	65	82
Oct. 24	57	42	49.5	83	74	78.5
Oct. 25*	79	40	59.5	....	....	....
Oct. 26*	58	41	49.5	90	29	59.5
Oct. 27	57	46	51.5	100	60	80
Oct. 28	52	31	41.5	100	54	77
Oct. 29	69	35	52	97	36	66.5
Oct. 30	74	34	54	98	36	67
Oct. 31	77	35	56	88	23	55.5
Nov. 1	79	39	59	87	47	67
Nov. 2	72	52	62	96	63	79.5
Nov. 3	67	52	59.5	99	67	83
Nov. 4	73	45	59	94	36	65
Nov. 5	69	42	55.5	93	37	65

*On the dates marked with an asterisk (*) record of the temperature was not secured at Mansura on account of the mechanism of the thermograph clock being out of order. On these dates we have therefore inserted the temperatures as recorded by the U. S. Weather Bureau at Alexandria, La., the nearest observing station.

†Similar records of weather conditions for the period during which weevils were emerging from hibernation (February 21 to June 29, 1909) are given on a subsequent page.

TABLE III.—(Continued.)

Date.	Temperature degrees F.			Humidity, per cent.		
	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.
Nov. 6	66	37	51.5	96	37	66.5
Nov. 7	83	39	61	97	33	65
Nov. 8	84	51	67.5	94	33	63.5
Nov. 9	80	55	67.5	94	40	67
Nov. 10	79	56	67.5	92	43	67.5
Nov. 11	75	48	61.5	92	64	78
Nov. 12	60	40	50	88	38	63
Nov. 13	55	38	46.5	90	43	66.5
Nov. 14	47	31	39	76	34	55
Nov. 15	55	24	39.5	92	30	61
Nov. 16	59	26	42.5	98	40	69
Nov. 17	66	26	46	99	32	65.5
Nov. 18	68	34	51	95	29	62
Nov. 19	76	45	60.5	95	48	71.5
Nov. 20	77	50	63.5	93	52	72.5
Nov. 21	77	49	63	94	48	71
Nov. 22	72	48	60	94	50	72
Nov. 23	79	52	65.5	93	41	67
Nov. 24	78	62	70	83	53	68
Nov. 25	83	66	74.5	79	40	59.5
Nov. 26	78	61	69.5	84	40	62
Nov. 27	76	57	66.5	83	40	61.5
Nov. 28	81	71	76	73	44	58.5
Nov. 29	79	62	70.5	86	50	68
Nov. 30*	68	58	63	....	....	....
Dec. 1	66	54	60	86	78	82
Dec. 2	60	38	49	83	30	56.5
Dec. 3	57	29	43	61	22	41.5
Dec. 4	69	40	54.5	82	57	69.5
Dec. 5	65	44	54.5	96	60	78
Dec. 6	77	58	67.5	97	67	82
Dec. 7	72	46	59	95	64	79.5
Dec. 8	55	40	47.5	80	34	57
Dec. 9	63	32	47.5	95	32	63.5
Dec. 10	64	47	55.5	94	66	80
Dec. 11	72	58	65	96	69	82.5
Dec. 12	63	45	54	94	47	70.5
Dec. 13	69	32	50.5	100	25	62.5
Dec. 14	75	43	59	91	59	75
Dec. 15	77	62	69.5	96	58	77
Dec. 16	77	58	67.5	99	63	81
Dec. 17	80	64	72	96	53	74.5
Dec. 18	76	61	68.5	99	70	84.5
Dec. 19	65	44	54.5	97	81	89
Dec. 20	54	48	51	83	67	75
Dec. 21	55	44	49.5	97	66	81.5
Dec. 22	52	37	44.5	93	52	72.5
Dec. 23	60	29	44.5	96	34	65
Dec. 24	68	34	51	97	58	77.5
Dec. 25	63	51	57	93	31	62
Dec. 26	60	29	44.5	92	25	58.5
Dec. 27	66	40	53	86	61	73.5
Dec. 28	71	56	63.5	91	63	77

TABLE III.—(Continued.)

Date.	Temperature.			Humidity, per cent.		
	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.
Dec. 29	68	60	64	93	76	84.5
Dec. 30	68	58	63	95	66	80.5
Dec. 31	63	48	55.5	86	28	57
Jan. 1	66	35	50.5	80	31	55.5
Jan. 2	68	35	51.5	93	30	61.5
Jan. 3	64	41	52.5	91	58	74.5
Jan. 4	69	58	63.5	95	64	79.5
Jan. 5	66	46	56	95	54	74.5
Jan. 6	65	40	52.5	96	55	75.5
Jan. 7	54	38	46	90	65	77.5
Jan. 8	49	36	42 5	90	68	79
Jan. 9	67	47	57	86	54	70
Jan. 10	72	54	63	86	61	73.5
Jan. 11	72	50	61	97	69	83
Jan. 12	56	28	42	93	72	82.5
Jan. 13	42	31	36.5	96	72	84
Jan. 14	65	42	53.5	95	90	92.5
Jan. 15	71	58	64.5	94	78	86
Jan. 16	66	57	61.5	94	80	87
Jan. 17	57	43	50	93	57	75
Jan. 18	48	33	40.5	92	79	85.5
Jan. 19	49	33	41	99	75	87
Jan. 20	**68**	**34**	**51**	**99**	**47**	**73**
Jan. 21	76	46	61	95	47	71
Jan. 22	79	60	69.5	95	59	77
Jan. 23	78	67	72.5	94	65	79.5
Jan. 24	80	66	73	94	55	74.5
Jan. 25	77	63	70	94	68	81
Jan. 26	80	62	71	96	54	75
Jan. 27	74	56	65	92	57	74.5
Jan. 28	77	57	67	98	49	73.5
Jan. 29	76	43	59.5	90	32	61
Jan. 30	43	29	36	45	30	37.5
Jan. 31	43	23	33	56	30	43
Feb. 1	42	23	32.5	77	41	59
Feb. 2	59	24	41.5	93	24	58.5
Feb. 3	68	26	47	97	21	59
Feb. 4	72	40	56	88	58	73
Feb. 5	76	58	67	94	33	63.5
Feb. 6	72	37	54.5	98	35	66.5
Feb. 7	70	43	56.5	89	22	55.5
Feb. 8	70	43	56.5	84	38	61
Feb. 9	72	57	64.5	97	34	65.5
Feb. 10	58	32	45	82	32	57
Feb. 11	68	32	50	97	36	66.5
Feb. 12	71	52	61.5	98	45	71.5
Feb. 13	78	67	72.5	97	69	83
Feb. 14	72	55	63.5	98	80	89
Feb. 15	56	27	41.5	95	80	87.5
Feb. 16	42	26	34	90	56	73
Feb. 17	56	27	41.5	95	42	68 5
Feb. 18	68	38	53	94	63	78.5
Feb. 19	67	43	55	95	35	65
Feb. 20	75	46	60.5	95	57	76

Records of the rainfall at Mansura could not be made earlier than December 8th as we could not secure the rain-gauge prior to that time. The rainfall by weeks, from December 8, 1908, to February 22, 1909, is given below:

Week ending.	Rainfall, in inches.
Dec. 14, 1908	.05
Dec. 21, 1908	1.04
Dec. 28, 1908	0.00
Jan. 4, 1909	.35
Jan. 11, 1909	.30
Jan. 18, 1909	.17
Jan. 25, 1909	0.00
Feb. 1, 1909	.08
Feb. 8, 1909	.06
Feb. 15, 1909	3.50
Feb. 22, 1909	1.12

During the period of 82 days elapsing from December 1st to February 21st, the date when the first weevils emerged from hibernation, there were 18 clear days, 46 cloudy days and 18 days which were partly cloudy. On 42 days of this period the wind blew from the north, northwest, or northeast, on 21 days from the south, southeast or southwest, on 19 days from the east and at no time from the west. On 12 days the velocity of the wind was estimated at from 10 to 20 miles per hour and on the remaining days at less than 10 miles. A velocity of 20 miles per hour was not exceeded at any time. The first noticeable frost occurred on October 28, 1908. The first autumn frost heavy enough to materially injure cotton foliage occurred on the night of November 14th, and by November 17th practically all cotton plants had been killed by frost.

CHAPTER III.

EMERGENCE OF THE BOLL WEEVILS FROM HIBERNATION.

In discussing the time at which the weevils were found to leave their winter quarters, we shall use the term "hibernation" in its broadest sense. There are some who maintain that an insect is not in hibernation unless it is in a condition of suspended animation and to all appearances dead. Others consider that an insect is "in hibernation" if it is in some situation where it is more or less protected from the weather, even though it may move about and show signs of activity. Hair-splitting of definitions is of little importance to the farmer and it does not matter from a practical standpoint whether a boll weevil is in a comatose condition all winter or whether it moves a wing or foot now and then. What affects the farmer is the number of weevils that live through the winter. Of equally as great importance to him is the time at which the over-wintered weevils seek his cotton fields in spring and summer. When we say that a boll weevil left hibernation upon a certain date we mean that it came forth from the trash or moss in which it was hidden and showed sufficient activity to either fly or crawl onto the wire screen with which the cages were covered. Observations made in a similar experiment at Keachie during the spring of 1906 showed that some boll weevils leave their hibernating quarters and, not finding green cotton to feed on, return to secluded situations in trash or leaves to "emerge" again later on. Detailed observations of this kind were not possible in the Mansura experiments, for as soon as a weevil made its appearance on the wire screen of the cages it was caught and removed. This was done to prevent any complication of the records which might cause uncertainty in the results. The cages were examined twice daily from February 15 to July 15, 1909, and every weevil was captured and removed as soon as it appeared. Thus there was no possibility of mistaking the dates upon which the weevils left the trash in the cages in which they hibernated.

PART I.

Daily Rate of Emergence from Hibernation of Weevils Passing the Winter in all Situations.

In the preceeding Chapter we gave the percentage of weevils surviving the winter in all cages of the experiment, that is, in the thirteen cages which were started weekly from September 28th to December 21st, all of which contained hibernating materials of a general nature, in one cage of the same kind located in the swamp and in two cages containing Spanish moss, one of which was located in the open field and the other in the swamp. Of the 16,281 adult boll weevils contained in all of these cages, 3,360* lived until February 15th or after and emerged.

The first of these emerged on February 21st and the last one on June 29th, so that the time during which they were leaving their winter quarters covered a period of 129 days, or over four months. The rate of this emergence can be accurately given only by a record showing the number of weevils emerging on each day of this period and this is done in Table IV, on a succeeding page. A general idea of this rate of emergence from winter quarters can be more easily gained, however, from the following statement of the number of weevils leaving hibernation during each ten-day period:

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*This number does not include the 41 weevils which were clinging to the wire cloth on February 15th, mention of which was made on page 172.

PERIOD.	Number of weevils leaving hibernation during the 10 days.
Feb. 21 to March 2	429
March 3 to March 12	229
March 13 to March 22	154
March 23 to April 1	301
April 2 to April 11	379
April 12 to April 21	198
April 22 to May 1	379
May 2 to May 11	239
May 12 to May 21	421
May 22 to May 31	317
June 1 to June 10	255
June 11 to June 20	46
June 21 to June 30	13
Total number of surviving weevils	3,360

The weekly rate of emergence from hibernation is graphically illustrated in Figure 4.

The following statement shows the number of weevils, out of the 3,360 which survived the winter, which were out of hibernation by certain dates, 10 days apart, through the spring and early summer. The percentage of the total number of *surviving weevils,* constituted by the number out at each date, is also given.

Date, 1909.	Number of weevils out of hibernation by this date.	Per cent of the total number surviving the winter.
Feb. 20	None*	0.00
March 2	429	12.76
March 12	658	19.58
March 22	812	24.17
April 1	1,113	33.12
April 11	1,492	44.40
April 21	1,690	50.29

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*See footnote on page 185.

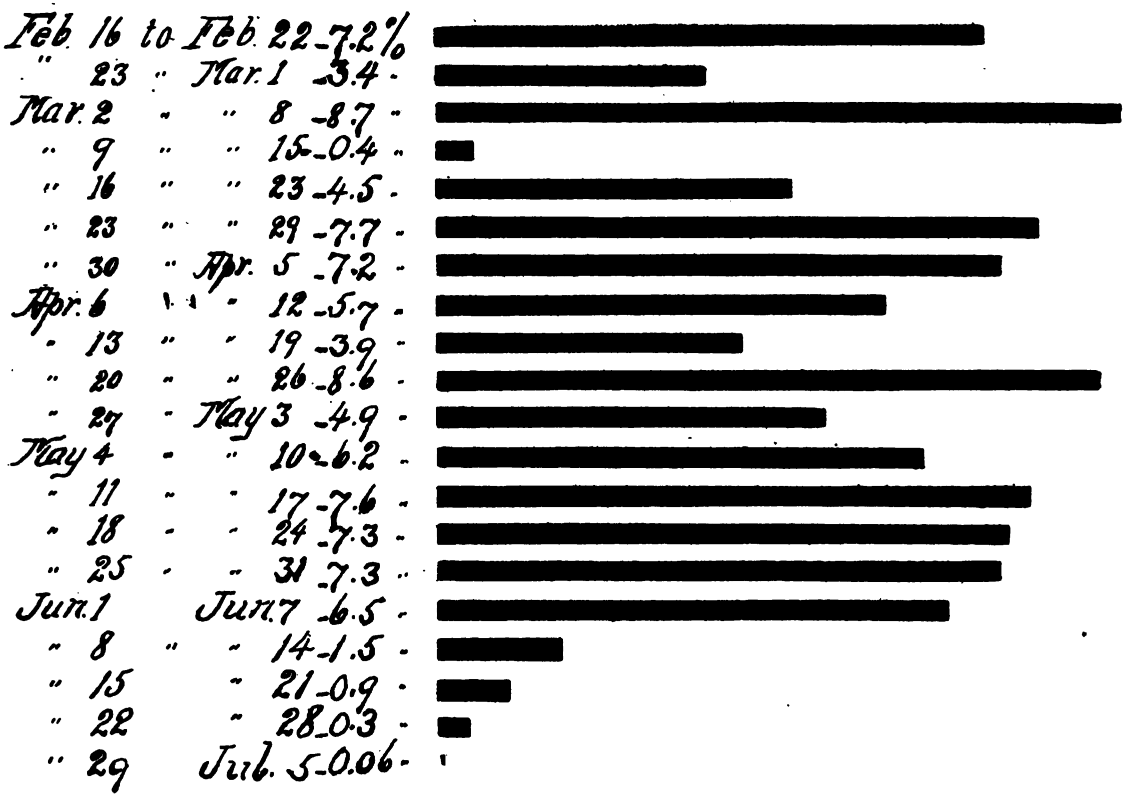

Fig. 4. Diagram showing relative number of weevils emerging from hibernation during each week from February 15 to July 5, 1909. (Original).

Date, 1909.	Number of weevils out of hibernation by this date.	Per cent of the total number surviving the winter.
May 1	2,069	61.58
May 11	2,308	68.69
May 21	2,729	81.22
May 31	3,046	90.66
June 10	3,301	98.24
June 20	3,347	99.61
June 30	3,360	100.00

The foregoing condensed statement of the rate at which the weevils left their winter quarters will doubtless suffice for the average farmer, but those who make a critical study of the weevil problem, particularly with reference to the late planting theory* and the problem of successfully poisoning the weevil, insist on our publishing such information as this in the minutest detail and for the benefit of such readers we append hereto a table showing the daily rate of emergence from hibernation of the 3,360 weevils which survived the winter in these experiments. Not only does the table give the number of weevils emerging each day, but it also gives the temperature and humidity (amount of moisture in the air) for each day of the 129.

TABLE IV.

DAILY RATE OF EMERGENCE FROM HIBERNATION OF 3,360 BOLL WEEVILS SURVIVING THE WINTER.

Date, 1909.	Weevils emerging.	Temperature.			Humidity.			Rainfall.	
		Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Week ending.	Inches.
Feb. 21	135	79	64	71.5	94	82	88		.....
Feb. 22	101	80	70	75	....	....	......	Feb. 22	1.12
Feb. 23	7	76	54	65	....	....	......		.....
Feb. 24	1	55	44	49.5	....	....	......		.....
Feb. 25	0	60	32	46	....	....	......		.....
Feb. 26	7	69	40	54.5	....	....	......		.....
Feb. 27	16	68	50	59	....	....	......		.....
Feb. 28	53	76	47	61.5	....	....	......		.....
March 1 ...	32	78	49	63.5	77	64	70.5	March 1	1.40
March 2 ...	77	83	66	74.5	95	33	64		.....

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*This theory is fully discussed in Circular No. 26 of the Commission, page 83, which see.

TABLE IV.—(Continued.)

Date, 1909.	Weevils emerging.	Temperature.			Humidity.			Rainfall.	
		Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Week ending.	Inches.
March 3 ...	17	76	52	64	94	27	60.5		.....
March 4 ...	12	67	47	57	78	35	56.5		.....
March 5 ...	19	79	50	64.5	92	56	74		.....
March 6 ...	80	82	68	75	93	58	75.5		.....
March 7 ...	59	83	66	74.5	97	47	72		.....
March 8 ...	30	80	70	75	88	60	74	March 8	0.0
March 9 ...	12	75	51	63	97	53	75		.....
March 10 ..	0	66	42	54	87	38	62.5		.....
March 11 ..	0	62	53	57.5	95	48	71.5		.....
March 12 ..	0	55	50	52.5	97	93	95		.....
March 13 ..	0	64	54	59	97	85	91		.....
March 14 ..	0	59	45	52	95	78	86.5		.....
March 15 ..	2	57	35	46	78	43	60.5	March 15 ...	2.27
March 16 ..	6	66	34	50	96	37	66.5		.....
March 17 ..	37	73	48	60.5	93	32	62.5		.....
March 18 ..	12	75	47	61	95	55	75		.....
March 19 ..	16	76	59	67.5	96	72	84		.....
March 20 ..	40	80	69	74.5	94	68	81		.....
March 21 ..	11	74	50	62	93	48	70.5		.....
March 22 ..	30	78	50	64	94	40	67	March 22 ...	0.10
March 23 ..	41	80	49	64.5	98	39	68.5		.....
March 24 ..	7	77	61	69	95	68	81.5		.....
March 25 ..	4	72	51	61.5	76	35	55.5		.....
March 26 ..	3	77	40	58.5	97	33	65		.....
March 27 ..	14	80	59	69.5	95	57	76		.....
March 28 ..	104	85	67	76	96	35	65.5		.....
March 29 ..	87	87	61	74	92	35	63.5	March 29 ...	0.0
March 30 ..	22	80	54	67	77	39	58		.....
March 31 ..	14	72	48	60	66	37	51.5		.....
April 1	5	71	55	63	66	45	55.5		.....
April 2	43	79	42	60.5	98	25	61.5		.....
April 3	69	85	48	66.5	95	28	61.5		.....
April 4	27	81	56	68.5	97	35	66		.....
April 5	62	83	62	72.5	96	56	76	April 5	0.0
April 6	37	83	75	79	87	72	79.5		.....
April 7	109	83	67	75	95	31	63		.....
April 8	8	77	55	66	96	38	67		.....
April 9	11	69	49	59	70	28	49		.....
April 10 ...	12	75	39	57	99	26	62.5		.....
April 11 ...	1	77	45	61	98	36	67		.....
April 12 ...	14	78	63	70.5	90	70	80	April 12	0.45
April 13 ...	3	72	48	60	97	40	68.5		.....
April 14 ...	6	69	42	55.5	99	36	67.5		.....
April 15 ...	20	77	48	62.5	95	36	65.5		.....
April 16 ...	26	80	49	64.5	99	45	72		.....
April 17 ...	31	83	56	69.5	98	47	72.5		.....
April 18 ...	32	85	59	72	96	47	71.5		.....
April 19 ...	14	84	63	73.5	95	50	72.5	April 19	1.75
April 20 ...	27	81	67	74	95	56	75.5		.....
April 21 ...	25	86	70	78	93	59	76		.....
April 22 ...	49	88	71	79.5	96	52	74		.....
April 23 ...	6	84	62	73	94	63	78.5		.....

TABLE IV.—(Continued.)

Date, 1909.	Weevils emerging.	Temperature.			Humidity.			Rainfall.	
		Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Week ending.	Inches.
April 24 ...	0	65	59	62	97	76	86.5		.....
April 25 ...	10	85	61	73	97	68	82.5		.....
April 26 ...	171	81	68	74.5	96	79	87.5	April 26	0.72
April 27 ...	24	80	66	73	95	74	84.5		.....
April 28 ...	63	88	64	76	96	60	78		.....
April 29 ...	34	87	75	81	90	63	76.5		.....
April 30 ...	16	85	71	78	95	73	84		.....
May 1	6	71	50	60.5	79	34	56.5		.....
May 2	2	74	44	59	99	34	66.5		.....
May 3	22	82	47	64.5	98	36	67	May 3	0.50
May 4	15	84	54	69	98	40	69		.....
May 5	24	86	57	71.5	96	50	73		.....
May 6	38	82	64	73	95	63	79		.....
May 7	77	88	62	75	97	43	70		.....
May 8	36	88	61	74.5	96	38	67		.....
May 9	17	84	68	76	92	54	73		.....
May 10	2	76	52	64	88	37	62.5	May 10	0.25
May 11	6	77	48	62.5	95	40	67.5		.....
May 12	20	85	49	67	99	31	65		.....
May 13	35	87	55	71	98	46	72		.....
May 14	48	89	66	77.5	94	48	71		.....
May 15	38	84	67	75.5	95	59	77		.....
May 16	85	85	64	74.5	96	55	75.5		.....
May 17	23	83	68	75.5	95	65	80	May 17	2.50
May 18	38	82	64	73	96	69	82.5		.....
May 19	98	81	64	72.5	96	55	75.5		.....
May 20	14	82	63	72.5	92	52	72		.....
May 21	22	83	65	74	94	49	71.5		.....
May 22	35	88	64	76	95	46	70.5		.....
May 23	26	90	66	78	94	48	71		.....
May 24	12	86	68	77	96	73	84.5	May 24	3.91
May 25	71	89	77	83	94	71	82.5		.....
May 26	2	81	67	74	96	85	90.5		.....
May 27	35	78	67	72.5	97	82	89.5		.....
May 28	51	84	68	76	96	70	83		.....
May 29	32	89	73	81	93	60	76.5		.....
May 30	17	87	74	80.5	94	60	77		.....
May 31	36	86	69	77.5	95	53	74	May 31	2.13
June 1	9	82	65	73.5	96	80	88		.....
June 2	11	75	66	70.5	96	88	92		.....
June 3	80	86	68	77	96	54	75		.....
June 4	58	88	72	80	92	41	66.5		.....
June 5	25	88	66	77	92	50	71		.....
June 6	17	91	66	78.5	97	47	72		.....
June 7	19	93	70	81.5	94	45	69.5	June 7	4.07
June 8	17	92	70	81	94	48	71		.....
June 9	10	93	69	81	97	50	73.5		.....
June 10	9	92	71	81.5	94	49	71.5		.....
June 11	5	93	71	82	95	48	71.5		.....
June 12	4	93	68	80.5	96	43	69.5		.....
June 13	2	94	72	83	95	44	69.5		.....
June 14	4	86	71	78.5	96	77	86.5	June 14	0.68
June 15	4	87	68	77.5	97	61	79		.....

TABLE IV.—(Continued.)

Date, 1909.	Weevils emerging.	Temperature.			Humidity.			Rainfall.	
		Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Week ending.	Inches.
June 16	7	93	70	81.5	95	51	73		.....
June 17	8	94	73	83.5	94	53	73.5		.....
June 18	6	92	73	82.5	93	58	75.5		.....
June 19	4	92	71	81.5	96	54	75		.....
June 20	2	89	71	80	95	61	78		.....
June 21	0	85	74	79.5	95	68	81.5	June 21	0.44
June 22	2	93	71	82	95	69	82		.....
June 23	2	94	71	82.5	96	50	73		.....
June 24	1	94	72	83	96	50	73		.....
June 25	1	94	71	82.5	95	53	74		.....
June 26	1	96	72	84	94	54	74		.....
June 27	3	92	74	83	96	63	79.5		.....
June 28	1	88	74	81	94	65	79.5	June 28	0.86
June 29	2	94	74	84	95	55	75		.....

The following table gives the direction of the wind each day during the period of emergence of the weevils from hibernation, its estimated velocity and the condition of the sky, that is, whether cloudy, clear or hazy. For convenience the following abbreviations are used in the table:

"Clr," clear
"C." cloudy.
"P. C." partly cloudy.
"H," hazy.
"N," north.
"E," east.
"S," south.
"W," west.
"N E," northeast, etc.

TABLE V.

DAILY CONDITIONS OF SKY AND WIND, FEBRUARY 21 TO JUNE 29, 1909.

Date, 1909.	Sky.	Wind.		Date, 1909.	Sky.	Wind.	
		Blew from the	Velocity, estimated, miles per hour.			Blew from the	Velocity, estimated, miles per hour.
Feb. 21	C	NW	6 to 10	April 27	C	SW	1 to 2
Feb. 22	C	S	6 to 10	April 28	P.C.	SW	2 to 3
Feb. 23	C	NE	6 to 10	April 29	P.C.	S	4 to 9
Feb. 24	Clr	NW	4 to 6	April 30	P.C.	S	4 to 8
Feb. 25	Clr	N&S	1 to 4	May 1	P.C.	N	5 to 10
Feb. 26	Clr	S	2 to 4	May 2	Clr	S	2
Feb. 27	H	S	1 to 2	May 3	Clr	NW	1 to 2
Feb. 28	H	S	1 to 3	May 4	P.C.	S	6 to 8
March 1	H	E	5 to 8	May 5	P.C.	S	2 to 5
March 2	P.C.	W	5	May 6	C	S	2 to 6
March 3	H	E	10	May 7	Clr	N	1 to 2

TABLE V.—(Continued.)

Date, 1909.	Sky.	Wind.		Date, 1909.	Sky.	Wind.	
		Blew from the	Velocity, estimated, miles per hour.			Blew from the	Velocity, estimated, miles per hour
March 4	H	N	2 to 5	May 8	P.C.	S	2 to 5
March 5	P.C.	SW	10 to 15	May 9	P.C.	SW	3 to 5
March 6	P.C.	S	3	May 10	P.C.	N	4 to 6
March 7	P.C.	SE	5	May 11	P.C.	S	1 to 5
March 8	C	S	10 to 25	May 12	Clr	S	2 to 4
March 9	C	W	2	May 13	P.C.	SW	2 to 6
March 10	Clr	N	5	May 14	P.C.	S	4
March 11	C	E	5 to 8	May 15	P.C.	SW	6 to 10
March 12	C	NW	5 to 10	May 16	P.C.	NE	1 to 3
March 13	C	N	0 to 8	May 17	C	S	0 to 4
March 14	C	N	5 to 10	May 18	C	NE	1 to 6
March 15	Clr	NW	5	May 19	C	N	2 to 6
March 16	H	N	2	May 20	P.C.	SW	1 to 4
March 17	Clr	SW	1	May 21	P.C.	NW	2 to 4
March 18	P.C.	SW	5	May 22	P.C.	N	1 to 3
March 19	C	S	1 to 4	May 23	Clr	S	2 to 4
March 20	C	SW	5 to 8	May 24	P.C.	S	2 to 5
March 21	P.C.	NW	1 to 4	May 25	P.C.	S	2 to 6
March 22	Clr	NW	1 to 3	May 26	C	S	2 to 8
March 23	P.C.	S	4 to 8	May 27	C	N	2 to 6
March 24	C	S	4 to 8	May 28	C	N	2 to 8
March 25	P.C.	N	10 to 20	May 29	P.C.	S	2 to 5
March 26	H	S	2 to 6	May 30	C	S	3 to 7
March 27	P.C.	SW	5 to 15	May 31	P.C.	S	0 to 4
March 28	H	SW	1 to 3	June 1	C	N	4 to 8
March 29	Clr	S	1 to 2	June 2	C	N	2 to 5
March 30	Clr	N	2 to 4	June 3	Clr	SW	1 to 3
March 31	Clr	N	2 to 6	June 4	P.C.	S	1 to 4
April 1	H	N	4 to 8	June 5	P.C.	S	2 to 4
April 2	H	NW	4 to 8	June 6	Clr	S	1 to 3
April 3	Clr	S	6 to 9	June 7	Clr	SW	0 to 2
April 4	P.C.	S	7 to 15	June 8	Clr	SW	0 to 2
April 5	C	S	10 to 15	June 9	P.C.	SW	0 to 2
April 6	C	S	8 to 12	June 10	P.C.	S	0 to 2
April 7	P.C.	NE	4 to 10	June 11	P.C.	SW	0 to 2
April 8	C	N	2 to 4	June 12	P.C.	SW	0 to 3
April 9	Clr	N	4	June 13	P.C.	SW	8
April 10	Clr	N	0 to 3	June 14	C	S	2 to 5
April 11	Clr	S	2 to 4	June 15	P.C.	S	0 to 4
April 12	C	S	10 to 15	June 16	P.C.	NE	0 to 2
April 13	Clr	N	8 to 15	June 17	P.C.	N	0 to 2
April 14	Clr	N	0 to 4	June 18	Clr	SW	0 to 5
April 15	Clr	SE	2 to 4	June 19	C	NE	10
April 16	Clr	S	0 to 3	June 20	P.C.	NE	0 to 5
April 17	Clr	S	0 to 4	June 21	P.C.	S	0 to 5
April 18	P.C.	S	2 to 5	June 22	P.C.	SE	2 to 5
April 19	P.C.	S	2 to 5	June 23	P.C.	SE	2 to 8
April 20	C	S	4 to 10	June 24	P.C.	S	1 to 4
April 21	P.C.	S	4 to 10	June 25	P.C.	SW	2 to 6
April 22	P.C.	S	4 to 8	June 26	C	NE	2 to 20
April 23	C	N	3 to 6	June 27	C	E	2 to 10
April 24	C	N	3 to 5	June 28	P.C.	N	2 to 6
April 25	C	S	2 to 5	June 29	P.C.	SE	13
April 26	P.C.	S	2 to 4				

The rather complete climatological data given in Tables IV and V make it possible for the reader to study, as critically as he may choose, the effect of different weather conditions upon the emergence of the weevils from hibernation at any given date or through any desired period.

PART 2.

Rate of Emergence of Boll Weevils From Hibernation in Spring, When Cotton Plants are Destroyed at Different Dates the Preceding Fall.

As pointed out on a preceding page, the confining of adult weevils in large cages, the latter containing a general assortment of materials in which the weevils normally hibernate, offers the most accurate means of determining what actually takes place among the weevils in the open fields and woods. The weevils confined in Cage 1 of the regular series on September 28, 1908, for example, had practically the same chances of surviving the winter as those weevils which were present in fields where all the cotton plants were destroyed on September 28th. It is also reasonable to suppose that the following spring the weevils in the cage would emerge from hibernation under the same weather conditions, and at the same rate, as would those escaping wholesale destruction of the cotton plants on the date the cage experiment was inaugurated.

The following table gives the rate of emergence of the weevils from their winter quarters in each of the cages started from September 28th to December 21st and we believe the results are accurately indicative of what followed in the field where cotton plants were destroyed at corresponding dates, that is, on September 28th, October 5th, October 12th, etc.

TABLE VI.

RATE OF EMERGENCE FROM HIBERNATION OF BOLL WEEVILS IN CAGES 1 TO 13, INCLUSIVE.*

Date, 1909	Number of weevils emerging from hibernation in cages started in the autumn of 1908.												
	Cage 1. Started Sept. 28 with 1037 weevils.	Cage 2. Started Oct. 5 with 1195 weevils.	Cage 3. Started Oct. 12 with 1132 weevils.	Cage 4. Started Oct. 19 with 922 weevils.	Cage 5. Started Oct. 26 with 1294 weevils.	Cage 6. Started Nov. 2 with 1326 weevils.	Cage 7. Started Nov. 9 with 1326 weevils.	Cage 8. Started Nov. 16 with 1420 weevils.	Cage 9. Started Nov. 23 with 1342 weevils.	Cage 10. Started Nov. 30 with 569 weevils.	Cage 11. Started Dec. 7 with 174 weevils.	Cage 12. Started Dec. 14 with 767 weevils.	Cage 13. Started Dec. 21 with 483 weevils.
Feb. 21 ..	2	1	5	1	15	20	8	12	11	5	0	15	26
Feb. 22 ..	2	1	3	2	15	16	9	8	9	9	0	11	7
Feb. 23 ..	0	0	0	1	1	0	0	2	0	0	3	0	0
Feb. 24 ..	0	0	0	0	0	0	0	1	0	0	0	0	0
Feb. 25 ..	0	0	0	0	0	0	0	0	0	0	0	0	0
Feb. 26 ..	0	0	0	0	0	3	1	0	0	0	0	0	2
Feb. 27 ..	0	0	0	0	3	1	0	0	3	0	0	0	2
Feb. 28 ..	0	1	1	0	4	10	2	5	5	7	2	4	6
Mar. 1 ...	3	0	1	0	3	6	4	0	1	0	0	4	6
Mar. 2 ...	1	1	3	1	8	5	4	7	4	7	2	8	13
Mar. 3 ...	0	0	2	0	1	0	2	1	0	4	1	2	0
Mar. 4 ...	2	0	1	0	2	5	0	0	0	1	0	0	1
Mar. 5 ...	0	1	0	0	3	0	1	1	2	1	0	4	1
Mar. 6 ...	0	2	4	1	4	10	7	6	9	8	1	9	9
Mar. 7 ...	1	0	2	1	8	11	3	4	2	3	1	7	3
Mar. 8 ...	0	0	1	0	2	5	1	5	2	1	0	4	4
Mar. 9 ...	0	0	1	0	3	1	2	0	0	0	2	1	1
Mar. 10 ..	0	0	0	0	0	0	0	0	0	0	0	0	0
Mar. 11 ..	0	0	0	0	0	0	0	0	0	0	0	0	0
Mar. 12 ..	0	0	0	0	0	0	0	0	0	0	0	0	0
Mar. 13 ..	0	0	0	0	0	0	0	0	0	0	0	0	0
Mar. 14 ..	0	0	0	0	0	0	0	0	0	0	0	0	0
Mar. 15 ..	0	0	0	0	1	0	0	0	0	0	0	0	0
Mar. 16 ..	0	0	0	0	1	0	0	0	0	0	0	3	1
Mar. 17 ..	0	0	0	0	4	5	2	6	5	5	0	5	3
Mar. 18 ..	0	0	0	0	2	1	2	0	0	2	1	1	1
Mar. 19 ..	1	1	1	0	1	6	1	0	2	2	0	1	0
Mar. 20 ..	0	0	1	0	10	10	2	3	1	2	1	5	0
Mar. 21 ..	0	0	0	0	3	2	2	0	2	0	0	1	0
Mar. 22 ..	0	0	1	0	4	0	1	5	3	1	0	7	2
Mar. 23 ..	1	0	1	0	4	5	4	4	2	3	0	6	8
Mar. 24 ..	0	0	0	0	2	0	2	1	0	1	0	0	0
Mar. 25 ..	0	0	0	0	1	0	1	1	0	0	0	0	0
Mar. 26 ..	0	0	0	0	0	0	0	0	0	0	0	0	3
Mar. 27 ..	1	0	1	0	2	0	1	1	1	1	0	3	0
Mar. 28 ..	3	0	9	0	12	9	12	10	6	10	1	11	5
Mar. 29 ..	1	0	0	1	5	17	7	6	4	13	0	10	10
Mar. 30 ..	0	0	0	0	3	4	3	0	1	1	1	2	2
Mar. 31 ..	0	0	0	0	2	1	2	1	1	1	0	0	0
April 1 ..	0	0	1	0	0	1	0	0	0	0	0	0	0

*For records of weather conditions prevailing during the period covered by this table see Tables IV and V.

TABLE VI.—(Continued.)

Date, 1909.	Cage 1. Started Sept. 28 with 1037 weevils.	Cage 2. Started Oct. 5 with 1195 weevils.	Cage 3. Started Oct. 12 with 1132 weevils.	Cage 4. Started Oct. 19 with 922 weevils.	Cage 5. Started Oct. 26 with 1294 weevils.	Cage 6. Started Nov. 2 with 1326 weevils.	Cage 7. Started Nov. 9 with 1326 weevils.	Cage 8. Started Nov. 16 with 1420 weevils.	Cage 9. Started Nov. 23 with 1342 weevils.	Cage 10. Started Nov. 30 with 569 weevils.	Cage 11. Started Dec. 7 with 174 weevils.	Cage 12. Started Dec. 14 with 67 weevils.	Cage 13. Started Dec. 21 with 183 weevils.
April 2 ..	0	0	1	0	4	5	2	2	3	4	0	12	1
April 3 ..	0	0	1	0	6	4	4	10	2	6	1	8	2
April 4 ..	0	0	1	0	1	2	1	2	5	1	0	1	0
April 5 ..	0	1	0	0	3	7	5	10	2	4	0	6	2
April 6 ..	0	1	0	0	9	4	6	1	2	3	0	0	3
April 7 ..	1	1	2	0	8	5	9	11	13	5	2	7	6
April 8 ..	0	0	0	0	1	1	3	1	2	0	0	0	0
April 9 ..	0	0	0	0	2	3	1	4	0	0	0	0	0
April 10 .	1	0	0	1	2	0	2	1	0	0	0	1	2
April 11 .	0	0	0	0	1	0	0	0	0	0	0	0	0
April 12 .	0	0	2	0	1	1	3	1	1	0	0	0	0
April 13 .	0	0	0	1	0	0	0	0	0	0	0	1	0
April 14 .	0	0	0	0	0	0	0	1	0	1	0	0	1
April 15 .	1	0	0	0	3	1	5	2	0	0	1	5	0
April 16 .	0	0	0	0	1	4	6	4	0	4	0	3	2
April 17 .	1	0	0	2	1	5	5	3	2	1	2	4	1
April 18 .	0	1	0	0	2	7	7	1	2	3	2	3	1
April 19 .	0	0	2	0	1	1	0	1	1	3	0	2	1
April 20 .	0	1	0	0	2	7	2	3	1	1	0	3	1
April 21 .	0	0	2	0	2	0	5	2	0	1	0	8	2
April 22 .	0	0	1	0	4	7	9	3	2	1	3	7	3
April 23 .	0.	0	0	0	2	0	1	1	0	0	1	0	0
April 24 .	0	0	0	0	0	0	0	0	0	0	0	0	0
April 25 .	0	0	0	0	0	7	0	0	0	1	0	1	1
April 26 .	1	0	3	1	26	16	41	32	4	10	2	14	5
April 27 .	0	1	1	0	0	0	6	5	1	0	0	3	1
April 28 .	0	0	3	0	9	2	6	12	2	2	0	8	3
April 29 .	0	0	0	0	3	1	2	4	4	1	0	5	2
April 30 .	0	0	0	0	2	1	2	0	0	0	0	4	3
May 1 ...	0	1	0	0	1	0	2	0	0	0	0	0	0
May 2 ...	0	0	0	0	0	0	0	2	0	0	0	0	0
May 3 ...	0	0	0	0	3	4	3	3	1	1	0	1	0
May 4 ...	0	0	0	0	1	3	0	3	1	1	0	1	2
May 5 ...	0	0	0	0	3	3	1	4	4	0	0	4	1
May 6 ...	0	0	0	0	5	4	4	2	3	4	2	3	4
May 7 ...	1	0	0	0	2	6	13	20	2	1	0	14	1
May 8 ...	0	0	0	0	7	6	2	7	2	1	1	2	0
May 9 ...	0	0	0	0	1	0	1	5	0	0	0	2	1
May 10 ..	0	0	0	0	0	0	0	0	0	0	0	0	1
May 11 ..	0	0	0	0	0	0	0	1	1	1	0	1	1
May 12 ..	0	0	0	0	4	2	2	2	0	1	1	2	0
May 13 ..	0	0	0	0	4	1	6	2	2	0	2	5	0
May 14 ..	1	0	0	0	5	4	5	6	1	2	1	6	0
May 15 ..	0	0	0	0	3	0	6	4	0	1	0	4	2
May 16 ..	1	0	1	1	9	7	10	13	1	0	0	19	1
May 17 ..	0	0	0	0	0	2	2	4	1	3	0	1	1

TABLE VI.—(Continued.)

Date, 1909.	Cage 1. Started Sept. 28 with 1037 weevils.	Cage 2. Started Oct. 5 with 1195 weevils.	Cage 3. Started Oct. 12 with 1132 weevils.	Cage 4. Started Oct. 19 with 922 weevils.	Cage 5. Started Oct. 26 with 1294 weevils.	Cage 6. Started Nov. 2 with 1326 weevils.	Cage 7. Started Nov. 9 with 1326 weevils.	Cage 8. Started Nov. 16 with 1420 weevils.	Cage 9. Started Nov. 23 with 1342 weevils.	Cage 10. Started Nov. 30 with 569 weevils.	Cage 11. Started Dec. 7 with 174 weevils.	Cage 12. Started Dec. 14 with 767 weevils.	Cage 13. Started Dec. 21 with 483 weevils.
May 18 ..	0	0	0	0	6	4	3	8	4	0	1	10	0
May 19 ..	0	0	0	1	1	2	7	15	3	0	1	10	1
May 20 ..	0	0	0	0	0	1	2	2	0	1	0	2	0
May 21 ..	0	0	0	0	2	2	2	4	0	1	1	3	1
May 22 ..	0	0	0	0	4	2	2	2	3	0	0	5	0
May 23 ..	0	0	0	0	0	2	0	7	5	0	0	0	0
May 24 ..	0	0	0	0	0	1	0	3	1	0	0	0	0
May 25 ..	0	0	0	0	5	2	4	3	0	4	0	5	0
May 26 ..	0	0	0	0	0	0	2	0	0	0	0	0	0
May 27 ..	0	0	0	0	5	1	4	6	1	1	0	5	0
May 28 ..	0	0	0	0	2	2	6	4	1	0	1	1	0
May 29 ..	0	0	0	0	6	1	2	3	1	0	0	6	1
May 30 ..	0	0	0	0	3	0	0	0	0	3	0	0	0
May 31 ..	0	0	0	0	6	0	4	6	0	0	0	2	0
June 1 ...	0	0	1	0	0	0	0	0	1	0	0	4	0
June 2 ...	0	0	0	0	0	0	0	3	0	0	0	0	0
June 3 ...	0	0	0	0	4	1	1	6	2	2	0	1	0
June 4 ...	0	0	0	0	3	1	1	4	0	0	0	2	0
June 5 ...	0	0	1	0	0	0	4	3	0	1	0	3	0
June 6 ...	0	0	1	0	0	0	0	0	1	0	0	1	0
June 7 ...	0	0	0	0	1	0	0	3	1	0	0	3	0
June 8 ...	1	0	0	0	1	0	1	4	0	0	0	0	2
June 9 ...	1	0	0	0	1	0	1	0	1	0	0	0	0
June 10 ..	0	0	0	0	0	0	0	1	0	0	0	5	0
June 11 ..	0	0	0	0	2	0	0	1	0	0	0	0	0
June 12 ..	0	0	0	0	0	0	0	0	0	0	0	0	0
June 13 ..	0	0	0	0	0	0	0	1	0	0	0	0	0
June 14 ..	0	0	0	0	0	0	0	0	0	0	0	0	0
June 15 ..	0	0	0	0	0	0	0	0	0	0	0	0	0
June 16 ..	0	0	0	0	0	0	0	0	0	0	0	0	0
June 17 ..	0	0	0	0	0	0	0	0	0	0	0	1	0
June 18 ..	0	0	0	0	0	0	0	1	1	0	0	0	0
June 19 ..	0	0	0	0	0	0	0	1	0	0	0	0	0
June 20 ..	0	0	0	0	0	0	0	0	0	0	0	0	0
June 21 ..	0	0	0	0	0	0	0	0	0	0	0	0	0
June 22 ..	0	0	0	0	0	0	0	1	0	0	0	0	0
June 23 ..	0	0	0	0	0	0	0	0	0	0	0	0	0
June 24 ..	0	0	0	0	0	0	1	0	0	0	0	0	0
June 25 ..	0	0	0	0	0	0	0	0	0	0	0	0	0
June 26 ..	0	0	0	0	0	0	0	1	0	0	0	0	0
June 27 ..	0	0	0	0	0	0	0	0	0	0	0	0	0
June 28 ..	0	0	0	0	0	0	0	0	0	0	0	0	0
June 29 ..	0	0	0	0	0	0	0	1	0	0	0	0	0

A rough idea of the rate at which the weevils emerged from hibernation in Cages 1 to 13 can be more readily gained from the following table than from Table VI, which requires some little study for a correct interpretation of its results. Table VII, compiled from the same data as Table VI, shows the dates at which 25 per cent, 50 per cent, 75 per cent and 100 per cent, respectively, of the weevils surviving the winter in these cages, were out of hibernation.

TABLE VII.

DATES, SPRING OF 1909, UPON WHICH DIFFERENT PERCENTAGES OF THE OVER-WINTERED WEEVILS WERE OUT OF WINTER QUARTERS.

Cage.	Date started, 1908.	Date by which 25 per cent of surviving weevils were out of hibernation.	Date by which 50 per cent were out of hibernation.	Date by which 75 per cent were out of hibernation.	Date by which all surviving weevils were out of hibernation.
1	Sept. 28	March 2	March 28	April 16	June 10
2	Oct. 5	March 3	March 20	April 19	May 2
3	Oct. 12	March 5	March 29	April 20	June 7
4	Oct. 19	Feb. 24	March 30	April 18	May 20
5	Oct. 26	March 21	April 10	May 9	June 12
6	Nov. 2	March 8	April 3	April 27	June 5
7	Nov. 9	March 30	April 24	May 9	June 25
8	Nov. 16	April 4	April 28	May 18	June 30
9	Nov. 23	March 7	April 5	May 6	June 19
10	Nov. 30	March 8	March 30	April 26	June 6
11	Dec. 7	March 10	April 18	May 7	May 29
12	Dec. 14	March 23	April 22	May 16	June 18
13	Dec. 21	March 2	March 24	April 17	June 9

A casual survey of the foregoing table shows that, in general, the earlier the weevils were confined in cages, the earlier in spring were the majority of them out of hibernation and active. Correspondingly, the earlier the cotton plants are destroyed in autumn, the sooner will the majority of the weevils be out of hibernation the following spring. Any step which results in the over-wintering weevils leaving hibernation early in the spring is of the utmost practical importance. Early emergence of the weevils from hibernation results in the death of many from old age before they have opportunity to deposit eggs in the first squares. Thus is the damage to the crop by succeeding weevil generations reduced.

The problem of poisoning the weevil would be greatly simplified by an early emergence of the bulk of the weevils for they are poisoned with comparative ease before the squares appear; afterwards only with great difficulty. It is the weevils emerging from hibernation after squares appear that nullify the good effects of poisoning the cotton while small and that have caused practically all attempts at poisoning the weevil to be failures so far as profit from the operation is concerned. That early fall destruction of the cotton plants does tend to cause a somewhat earlier emergence from hibernation, in addition to its other benefits, is indicated by Table VII.

PART 3.

Rate of Spring Emergence from Hibernation of Boll Weevils Hibernating in Moss, and of those Hibernating in Average Winter Quarters.

Reference has already been made (page 178) to the important fact that nearly twice as many of the weevils which sought winter quarters in moss on the trees survived the winter, as of those which sought refuge in other materials such as grass, leaves, rubbish, etc. The dangerous nature of the moss does not end, however, with its furnishing superior winter protection to the weevils. It would be a distinct advantage to the cotton planter were all boll weevils to emerge from their winter quarters as early as possible in the spring. Such an early emergence would permit of the crop making fruit during June and July with a minimum amount of damage from the weevil. It would also make possible the profitable use of poisons for destruction of the weevils before the crop commences squaring. It is found that the weevils which pass the winter in moss do not leave it as early as those which pass the winter in other materials. The weevils hibernating in the moss are therefore doubly injurious, for the bulk of them make their appearance when squares are available on which they can subsist and in which they can deposit their eggs. Appearing at a comparatively late date, they produce a relatively heavy infestation at a time when—in localities where the moss does not occur—there is a pronounced paucity of weevils prior to the first summer brood of adults and during which period the bulk of the bolls constituting the crop are put on by the plants.

The rate of spring emergence of the weevils hibernating in moss, as compared to the rate of emergence of those hibernating in average materials, was determined at Mansura by the use of four large cages, specially planned for the purpose. Cages No. 5 and 51 both contained average hibernating quarters. No. 5 was one of the regular series cages located in the open field, reference to which has been made in the preceding tables. Cage 51 did not differ from it in any particular except that it was located in the shelter of trees in the adjoining swamp. Cages A and B contained moss only. A was located in the open field and Cage B, like No. 51, was located in the swampy woodland. In the following table we have combined the emergence of weevils from Cages 5 and 51 and for comparison with it have combined the emergence from the two moss cages. As one of the latter was located in the open and one in the swamp the conditions in both represented the extremes presented by moss on trees in both situations.

TABLE VIII.

COMPARATIVE RATE OF EMERGENCE FROM HIBERNATION, WEEVILS HIBERNATING IN MOSS AND IN OTHER MATERIALS.

Date, 1909.	Daily Emergence.		Date, 1909.	Daily Emergence.	
	In Cages 5 and 51, containing general assortment of hibernating materials, started Oct. 26, 1908, with a total of 2436 weevils.	In Cages A and B, containing moss only, started Oct. 26, 1908, with a total of 2152 weevils.		In Cages 5 and 51, containing general assortment of hibernating materials, started Oct. 26, 1908, with a total of 2436 weevils.	In Cages A and B, containing moss only, started Oct. 26, 1908, with a total of 2152 weevils.
Feb. 21	22	7	April 27	0	6
Feb. 22	18	6	April 28	15	10
Feb. 23	1	0	April 29	4	11
Feb. 24	0	0	April 30	4	2
Feb. 25	0	0	May 1	3	0
Feb. 26	1	0	May 2	0	0
Feb. 27	8	2	May 3	4	5
Feb. 28	6	4	May 4	1	3
March 1	5	2	May 5	3	4
March 2	14	7	May 6	5	7
March 3	4	1	May 7	2	17
March 4	2	0	May 8	8	7
March 5	4	4	May 9	2	6
March 6	6	8	May 10	0	1
March 7	12	9	May 11	0	1
March 8	5	2	May 12	4	6
March 9	3	1	May 13	5	12
March 10 ...	0	0	May 14	6	16
March 11 ...	0	0	May 15	4	17
March 12 ...	0	0	May 16	16	15

TABLE VIII.—(Continued.)

Date, 1909.	Daily Emergence.	
	In Cages 5 and 51, containing general assortment of hibernating materials, started Oct. 26, 1908, with a total of 2436 weevils.	In Cages A and B, containing moss only, started Oct. 26, 1909, wth a total of 2152 weevils.
March 13 ...	0	0
March 14 ...	0	0
March 15 ...	2	0
March 16 ...	2	0
March 17 ...	6	0
March 18 ...	3	1
March 19 ...	1	0
March 20 ...	12	3
March 21 ...	3	1
March 22 ...	7	3
March 23 ...	4	3
March 24 ...	2	1
March 25 ...	1	1
March 26 ...	0	0
March 27 ...	3	2
March 28 ...	15	13
March 29 ...	7	11
March 30 ...	3	5
March 31 ...	2	6
April 1	2	1
April 2	5	8
April 3	11	20
April 4	6	8
April 5	7	18
April 6	9	8
April 7	14	33
April 8	1	0
April 9	2	1
April 10	2	2
April 11	1	0
April 12	2	4
April 13	0	1
April 14	1	2
April 15	3	2
April 16	1	2
April 17	4	1
April 18	2	3
April 19	1	2
April 20	2	6
April 21	2	3
April 22	5	8
April 23	3	0
April 24	0	0
April 25	0	0
April 26	30	12
May 17	3	6
May 18	6	2
May 19	19	39
May 20	0	6
May 21	4	4
May 22	5	16
May 23	1	11
May 24	1	6
May 25	9	44
May 26	0	0
May 27	5	12
May 28	4	32
May 29	6	12
May 30	4	10
May 31	9	15
June 1	0	3
June 2	1	7
June 3	6	61
June 4	6	44
June 5	2	11
June 6	1	13
June 7	1	11
June 8	1	6
June 9	2	5
June 10	0	3
June 11	2	2
June 12	0	4
June 13	0	1
June 14	0	4
June 15	0	4
June 16	1	6
June 17	0	7
June 18	0	4
June 19	0	3
June 20	0	2
June 21	0	0
June 22	0	1
June 23	1	1
June 24	0	0
June 25	0	1
June 26	0	0
June 27	1	2
June 28	0	1
June 29	0	1
Total	487	817

The rate of emergence of the weevils from moss and from general hibernating quarters can be readily, though roughly, compared by consulting the following table, compiled from the same data as Table VIII:

TABLE IX.

COMPARISON OF EMERGENCE RATE, WEEVILS HIBERNATING IN MOSS AND IN OTHER MATERIALS

Character of hibernating quarters.	Date by which 25 per cent of the surviving weevils were out of hibernation.	Date by which 50 per cent of the surviving weevils were out of hibernation.	Date by which 75 per cent of the surviving weevils were out of hibernation.	Date by which all surviving weevils were out of hibernation.
Moss (Cages A and B)......	April 13	May 20	June 2	June 29
Av. quarters (Cages 5 and 51)	March 19	April 12	May 15	June 27

Figure 5 shows graphically and in a striking manner how the weevils hibernating in moss (Cage B) remained in hibernation until late in spring and then emerged in enormous numbers late in May and early in June.

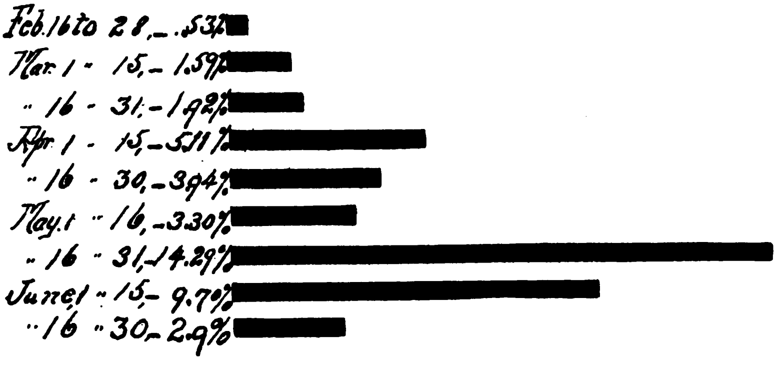

Fig. 5. Diagram showing relative number of weevils emerging from Spanish moss in the woods, by semi-monthly periods, from February 15 to July 1, 1909. (Original).

PART 4.

Rate of Emergence of Boll Weevils from Hibernation when Hibernating in the Open Field and When Hibernating in the Woods.

This comparison is obtained from the results in Cages 5, 51, A and B. Cage 5 (containing an average assortment of hibernating materials) and Cage A (containing moss only) were located in the open field, while Cage 51 (average hibernating quarters) and Cage B (moss) were located in the nearby swamp where they were protected from heavy winds and where they were sheltered from the rays of the sun after the trees leaved out in early spring. It is worthy of note, at the same time, that the two latter cages were subject to overflow from the adjacent creek. On February 13th Cage 51 was flooded for six hours and the rubbish in it covered with about six inches of water. It was flooded a second time with six inches of water on February 28th, for about five hours. A third flooding of this cage for five hours occurred on May 18th and on June 1st both 51 and B were again flooded; 51 with about 2½ feet of water, which remained on for two days, and B with about 4 inches which remained for a day.

It will be noticed that the combined emergence from Cages B and 51 was very little less than that of A and 5, though the emergence from B was 2.6 per cent more than from A. On the other hand, Cage 51, instead of showing a greater emergence than Cage 5, showed 10.9 per cent less. This falling off in the percentage of emergence in Cage 51 was probably due to the several floodings, during which the rubbish containing the hibernating weevils remained completely submerged in cold water for hours at a time. Cage B, although in the swamp, too, was on higher ground and was flooded but once. Even then the hibernating material (moss) in this cage was held off the ground by limbs and was only partially submerged.

TABLE X.

COMPARATIVE RATE OF EMERGENCE FROM HIBERNATION OF BOLL WEEVILS HIBERNATING IN THE OPEN FIELD AND IN WOODS OR SWAMP.*

Date, 1909.	Emergence from cages in open field, started Oct. 26, 1908.			Emergence from cages in swamp, started Oct. 26, 1908.		
	Cage 5 (average conditions) 1294 weevils confined.	Cage A (moss) 1214 weevils confined.	Total daily emergence, open field.	Cage 51 (average conditions) 1142 weevils confined.	Cage B (moss) 938 weevils confined.	Total daily emergence, cages in swamp
Feb. 21	15	4	19	7	3	10
Feb. 22	15	6	21	3	0	3
Feb. 23	1	0	1	0	0	0
Feb. 24	0	0	0	0	0	0
Feb. 25	0	0	0	0	0	0
Feb. 26	0	0	0	1	0	1
Feb. 27	3	2	5	5	0	5
Feb. 28	4	2	6	2	2	4
March 1	3	0	3	2	2	4
March 2	8	5	13	6	2	8
March 3	1	1	2	3	0	3
March 4	2	0	2	0	0	0
March 5	3	3	6	1	1	2
March 6	4	4	8	2	4	6
March 7	8	4	12	4	5	9
March 8	2	2	4	3	0	3
March 9	3	0	3	0	1	1
March 10	0	0	0	0	0	0
March 11	0	0	0	0	0	0
March 12	0	0	0	0	0	0
March 13	0	0	0	0	0	0
March 14	0	0	0	0	0	0
March 15	1	0	1	1	0	1
March 16	1	0	1	1	0	1
March 17	4	0	4	2	0	2
March 18	2	1	3	1	0	1
March 19	1	0	1	0	0	0
March 20	10	0	10	2	3	5
March 21	3	0	3	0	1	1
March 22	4	3	7	3	0	3
March 23	4	3	7	0	0	0
March 24	2	1	3	0	0	0
March 25	1	0	1	0	1	1
March 26	0	0	0	0	0	0
March 27	2	0	2	1	2	3
March 28	12	8	20	3	5	8
March 29	5	9	14	2	2	4
March 30	3	2	5	0	3	3
March 31	2	5	7	0	1	1

*For the record of temperatures prevailing during the period of emergence see Table IV.

TABLE X.—(Continued.)

Date, 1909.	Emergence from cages in open field, started Oct. 26, 1908.			Emergence from cages in swamp, started Oct. 26, 1908.		
	Cage 5 (average conditions) 1294 weevils confined.	Cage A (moss) 1214 weevils confined.	Total daily emergence, open field.	Cage 51 (average conditions) 1142 weevils confined.	Cage B (moss) 938 weevils confined.	Total daily emergence, cages in swamp.
April 1	0	0	0	2	1	3
April 2	4	2	6	1	6	7
April 3	6	12	18	5	8	13
April 4	1	4	5	5	4	9
April 5	3	11	14	4	7	11
April 6	9	6	15	0	2	2
April 7	8	17	25	6	16	22
April 8	1	0	1	0	0	0
April 9	2	0	2	0	1	1
April 10	2	2	4	0	0	0
April 11	1	0	1	0	0	0
April 12	1	3	4	1	1	2
April 13	0	0	0	0	1	1
April 14	0	1	1	1	1	2
April 15	3	2	5	0	0	0
April 16	1	1	2	0	1	1
April 17	1	1	2	3	0	3
April 18	2	2	4	0	1	1
April 19	1	1	2	0	1	1
April 20	2	2	4	0	4	4
April 21	2	1	3	0	2	2
April 22	4	6	10	1	2	3
April 23	2	0	2	1	0	1
April 24	0	0	0	0	0	0
April 25	0	0	0	0	0	0
April 26	26	1	27	4	11	15
April 27	0	2	2	0	4	4
April 28	9	7	16	6	3	9
April 29	3	3	6	1	8	9
April 30	2	2	4	2	0	2
May 1	1	0	1	2	0	2
May 2	0	0	0	0	0	0
May 3	3	4	7	1	1	2
May 4	1	2	3	0	1	1
May 5	3	3	6	0	1	1
May 6	5	5	10	0	2	2
May 7	2	11	13	0	6	6
May 8	7	6	13	1	1	2
May 9	1	5	6	1	1	2
May 10	0	0	0	0	1	1
May 11	0	1	1	0	0	0
May 12	4	3	7	0	3	3
May 13	4	5	9	1	7	8
May 14	5	14	19	1	2	3
May 15	3	12	15	1	5	6
May 16	9	7	16	7	8	15

TABLE X.—(Continued.)

Date, 1909.	Emergence from cages in open field, started Oct. 26, 1908.			Emergence from cages in swamp, started Oct. 26, 1908.		
	Cage 5 (average conditions) 1294 weevils confined.	Cage A (moss) 1214 weevils confined.	Total daily emergence, open field.	Cage 51 (average conditions) 1142 weevils confined.	Cage B (moss) 938 weevils confined.	Total daily emergence, cages in swamp.
May 17	0	2	2	3	4	7
May 18	6	2	8	0	0	0
May 19	1	8	9	18	31	49
May 20	0	4	4	0	2	2
May 21	2	3	5	2	1	3
May 22	4	9	13	1	7	8
May 23	0	8	8	1	3	4
May 24	0	1	1	1	5	6
May 25	5	14	19	4	30	34
May 26	0	0	0	0	0	0
May 27	5	5	10	0	7	7
May 28	2	14	16	2	18	20
May 29	6	6	12	0	6	6
May 30	3	6	9	1	4	5
May 31	6	5	11	3	10	13
June 1	0	3	3	0	0	0
June 2	0	2	2	1	5	6
June 3	4	22	26	2	39	41
June 4	3	28	31	3	16	19
June 5	0	8	8	2	3	5
June 6	0	10	10	1	3	4
June 7	1	6	7	0	5	5
June 8	1	2	3	0	4	4
June 9	1	0	1	1	5	6
June 10	0	2	2	0	1	1
June 11	2	0	2	0	2	2
June 12	0	3	3	0	1	1
June 13	0	1	1	0	0	0
June 14	0	1	1	0	3	3
June 15	0	0	0	0	4	4
June 16	0	0	0	1	6	7
June 17	0	0	0	0	7	7
June 18	0	0	0	0	4	4
June 19	0	0	0	0	3	3
June 20	0	2	2	0	0	0
June 21	0	0	0	0	0	0
June 22	0	0	0	0	1	1
June 23	0	0	0	1	1	2
June 24	0	0	0	0	0	0
June 25	0	0	0	0	1	1
June 26	0	0	0	0	0	0
June 27	0	0	0	1	2	3
June 28	0	0	0	0	1	1
June 29	0	0	0	0	1	1
Total	325	409	734	162	408	570

The dates upon which different percentages of the surviving weevils were out of hibernation, both in the open field and in the swamp, are given in the following table:

TABLE XI.

COMPARISON OF EMERGENCE RATE, WEEVILS HIBERNATING IN OPEN FIELD AND SWAMP.

Where hibernated.	Date by which 25 per cent were out of hibernation.	Date by which 50 per cent were out of hibernation.	Date by which 75 per cent were out of hibernation.	Date by which all surviving weevils were out of hibernation.
Open field (Cages A and 5)..	March 31	April 29	May 24	June 21
In swamp (Cages B and 51).	April 8	May 20	June 1	June 29

It is thus seen that the weevils hibernating in cool and shaded locations, as in the woods, do not leave hibernation until the summer heat has risen sufficiently for these places to be warmed to the temperature reached in the open fields one to three weeks earlier.

PART 5.

Length of Time Weevils Remain in Hibernation.

The question is often asked: "How long do the weevils remain in their hibernating quarters?" Another question almost as frequent is: "How long can the weevils live without food?" To both of these questions a partial answer is found in the data obtained from these experiments. We know when each weevil in the experiments was taken from the cotton field and locked up in a cage without food; we also know upon what date each weevil, surviving the winter, left its hibernating place in spring. This does not give, strictly speaking, the length of time these weevils were actually *in hibernation*, for many of the weevils confined in these cages—as for example, those shut up in Cage No. 1 on September 28th—did not enter hibernation at once, but remained for days or even several weeks, flying and crawling about the interior of the cages before deciding to enter the protective trash or moss provided for them. The period from the time the weevils were placed in the cage until they emerged the following spring was, in reality, the time elapsing from the day they were deprived of food until they emerged from hibernation. This information is of even more importance than knowing the exact interval during which the weevils were in a dormant, or semi-dormant, condition; it is the *length of time they lived without food.* The average number of days these overwintering weevils lived without food has been arrived at by consulting the record of each one of the 3,360 boll weevils which survived the winter and ascertaining the number of days elapsing from the date it was shut up in a cage until it emerged from hibernation. These periods were then averaged, the average representing, of course, the average length of time the weevils lived without food.

"WEEVIL-DAYS."

In making these averages recourse was had to a short method involving the use of a product designated as a "weevil-day." The use of this may be illustrated in the following manner:

In Cage 1, in which 1,037 weevils were confined on September 28, 1908, the first emergence occurred on February 21, 1909, two weevils emerging on that date. These two weevils had remained in the cage without food for 147 days (Sept. 28 to Feb. 21, inclusive). On February 22nd two more weevils emerged from hibernation, having remained in the cage without food for 148 days. The next emergence was on March 1st, three more weevils coming out of hibernation on that day. These three had been without food for 155 days. If we now add together the number of days which each of these seven weevils lived without food we shall have:

147
147
148
148
155
155
155
———
1,055

Dividing this sum (1,055) by the number of weevils (7), we get 150.7 days as the average time these weevils lived in the cages without food. But the same result can be arrived at by a simpler process. If we multiply the number of weevils emerging each day by the number of days elapsing from the date of their confinement, adding the products ("weevil-days") and then dividing by the number of weevils involved we will get the same result, thus:

$147 \times 2 = 294$ "weevil-days"
$148 \times 2 = 296$ "weevil-days"
$155 \times 3 = 465$ "weevil-days"

Total 1,055 "weevil-days"

$1{,}055 \div 7 = 150.7$, the average number of days the weevils lived without food before leaving hibernating quarters.

This process was continued in case of all weevils emerging from hibernation in the cages. The facts established were as follows:

The average time which the 3,360 over-wintering weevils remained without food before emerging from hibernation was 159 days.*

The weevil living the longest, without food, before emerging from hibernation, was one of the weevils contained in Cage No. 1; this weevil went without food from September 28, 1908, to June 9, 1909, a period of 255 days, before it emerged from hibernation.

That the time of fall destruction of the cotton plants materially alters the length of time the weevils are compelled to live without food during the hibernating season is well shown in the following table:

TABLE XII.

LENGTH OF TIME WEEVILS LIVED BEFORE EMERGING FROM HIBERNATION, WHEN DEPRIVED OF FOOD AT DIFFERENT DATES IN THE FALL.

Cage No.	Date started, 1908.	Nature of hibernating quarters.	Location of cage.	Weevils contained.	Weevils surviving the winter.	Average number of days in hibernation.†
1	Sept. 28	Average	In open field	1037	28	183.5
2	Oct. 5	Average	In open field	1195	15	170.7
3	Oct. 12	Average	In open field	1132	62	167.5

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*This statement does not include the 41 weevils which were still clinging to the wire screen of the cages on February 15th. It is not known whether or not they entered hibernation at all. (See page 170).

†That is, the length of time elapsing between confinement of the weevils in the cages and their emergence from the hibernating material, as explained in the text preceding this table.

TABLE XII.—(Continued.)

Cage No.	Date started, 1908.	Nature of hibernating quarters.	Location of cage.	Weevils contained.	Weevils surviving the winter.	Average number of days in hibernation.
4	Oct. 19	Average	In open field	922	15	160.7
5	Oct. 26	Average	In open field	1294	325	169.1
51	Oct. 26	Average	In swamp	1142	162	173.3
A	Oct. 26	Moss	In open field	1214	409	190.9
B	Oct. 26	Moss	In swamp	938	408	199.4
6	Nov. 2	Average	In open field	1326	309	153.3
7	Nov. 9	Average	In open field	1326	323	161.3
8	Nov. 16	Average	In open field	1420	379	159.1
9	Nov. 23	Average	In open field	1342	170	135.5
10	Nov. 30	Average	In open field	569	169	124.9
11	Dec. 7	Average	In open field	174	41	123.6
12	Dec. 14	Average	In open field	767	366	124.5
13	Dec. 21	Average	In open field	483	179	94.5

The information brought to light by the foregoing table is of the utmost importance. It is seen, for example, that when all cotton plants are destroyed by about October 1st the average weevil must live for 183 days without food before emerging from hibernation. When they are destroyed by October 12th the weevils have to withstand starvation for an average time of 167 days, and so on, until we see that when cotton plants are not destroyed prior to December 21st—which is equivalent to not destroying them at all—the average weevil has but 94 days to remain without food before leaving hibernating quarters. What wonder then that the weevils survive the winter in such destructive numbers when the cotton plants are left standing until mid-winter? The effect of early fall destruction of the cotton plants in lengthening the hibernating period of the weevil could not be more convincingly shown than by this table, and it goes without saying that the longer the weevils must subsist without food (growing cotton*) the less of them there will be to attack the next crop.

Consideration of the above table also reveals the interesting fact that weevils hibernating in the cool shaded situations in timber remained in hibernation an average of about 7 days longer than those hibernating in the open field.

Weevils which hibernated in moss in the swamp (Cage B) remained in hibernation practically 200 days and those which passed the winter in moss on trees in the open field (Cage A) remained in hibernation 191 days. In marked contrast to this, the weevils that hibernated in a general assortment of materials in the open field (Cage 5) remained in hibernation but 169 days, though gathered from the cotton fields at exactly the same date in the fall of 1908. Thus do we again see the dangerous nature of the moss, for it really causes the weevils in it to remain in hibernation for nearly a month longer than they would if hibernating in other materials. Thus we see the importance of the farmer selecting for cotton, such fields as are furthest removed from timber and we see at the same time the importance of removing from his fields the occasional moss-covered trees which frequently occur there.

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*Let us again emphasize the fact that the boll weevil has no other food than growing cotton and that it cannot subsist on anything else, newspaper stories to the contrary notwithstanding.

These observations, as well as those on the rate of emergence from hibernation, point to the opinion that it is the temperature prevailing *in the exact spot* where the individual weevils are hibernating that determines the date of emergence from hibernation. Piles of grass in the open field are warmed by the sun in February and March and we find the weevils emerging from them at that time. The shaded places of the forest or swamp are cool and damp and they do not reach an equivalent temperature until some weeks afterwards; we find the weevils emerging later in such places than in the open fields. The bunches of moss are resistant to heat and even in the hottest days of summer one can thrust his hand into a large bunch of it and meet with a refreshing coolnesss. Nothing less than severe summer heat can raise the temperature inside the moss bunches to that which is attained on the open field in March. Hence the explanation of why the weevils in the moss remain so long in hibernation.*

CHAPTER IV.

LENGTH OF TIME WEEVILS LIVE AFTER LEAVING HIBERNATION.

Attention has been called in the preceding pages to the important bearing which the rate of weevil emergence has upon the problem of poisoning the weevil successfully and on the question of when to plant the cotton crop to best advantage. Of hardly less importance is the length of time the over-wintered weevils live after leaving hibernating quarters, for this governs the amount of damage they themselves can do to the crop in its infancy; it also determines the extent to which the over-wintered females can deposit eggs in the first squares. This in turn determines the size of the second and third summer generations and the amount of damage they can do. It would have been interesting to learn how long the over-wintered weevils could live if there had been no cotton for them to feed upon. However, as cotton is usually up during the major part of the time during which weevils are emerging from hibernation it was deemed of even more importance to find out how long the weevils could live if permitted to feed upon the young growing cotton. Both lines of experimental work could not be carried out in full owing to our having an insufficient number of men to make the daily observations required. Hence the latter line of investigation was adopted. For convenience we shall hereafter use the term "longevity" to designate the length of time the weevils lived *after leaving hibernation.* The longevity of the weevils was determined by taking them, as they emerged from hibernation in the large cages, already described, and placing them in small cages known as "longevity cages." The weevils placed in each longevity cage were counted and from time to time the cage was examined and a record made of the number of weevils alive, number dead and number missing. In the final compilation weevils which were missing and not subsequently found were counted as dead.*

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*The tendency of this moss to remain cool is taken advantage of in some of the rural districts of Texas, where ice is not obtainable, for the preservation of meats, butter, etc. The food stuffs to be kept cool are merely wrapped in enormous bunches of the moss.

These observations were continued from day to day as long as any of the weevils were alive. A number of these small "longevity cages" are shown in Figure 6. To avoid errors the observations made in these small cages were recorded on charts, one chart being devoted to each cage. The following is a copy of one of these charts, showing the method used:

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*In cage experiments, as well as in the open cotton field, weevils are devoured or carried away, almost as soon as they die, by ants and other predaceous insects. Hence the impossibility of finding all insects used in an experiment.

(Copy of Chart.)

"SURVIVAL OF HIBERNATED BOLL WEEVILS IN LONGEVITY CAGE NO 137, MANSURA, LA., 1909. (COTTON PROVIDED).

"Number of weevils confined, 19. Date weevils were confined, April 22, 1909. Weevils from large Cages VII and VIII."

Examination.	Date of examination.	Original number.	Number alive.	Number dead.	Number missing.	Number dead and missing.	Natural Mortality.	
							During	Per cent dead and missing.
1st	April 24	19	18	0	1	1	2 days	5.26
2nd	April 26	19	17	1	1	2	4 "	10.53
3rd	April 28	19	17	1	1	2	6 "	10.53
4th	April 30	19	17	1	1	2	8 "	10.53
5th	May 2	19	13	4	2	6	10 "	31.58
6th	May 4	19	11	6	2	8	12 "	42.11
7th	May 6	19	3	14	2	16	14 "	84.21
8th	May 8	19	1	16	2	18	16 "	94.74
9th	May 10	19	1	16	2	18	18 "	94.74
10th	May 12	19	1	16	2	18	20 "	94.74
11th	May 14	19	1	16	2	18	22 "	94.74
12th	May 16	19	1	16	2	18	24 "	94.74
13th	May 18	19	1	16	2	18	26 "	94.74
14th	May 20	19	1	16	2	18	28 "	94.74
15th	May 22	19	1	16	2	18	30 "	94.74
16th	May 24	19	0	17	2	19	32 "	100.00

At the time the first weevils emerged in February and March no young cotton was obtainable for them to feed on and none could be secured, as the weather was too cool to permit germination of the cotton seed which we had planted in anticipation of these experiments. The earlier records of longevity were therefore made in cages which contained no cotton. These records are interesting in showing how long the early-emerging weevils can live, after leaving their winter shelter, until the first cotton is up. Later, when cotton seed could be induced to germinate, growing cotton plants were kept in each of the small "longevity cages." A supply of cotton, growing in tin cans, was kept constantly on hand and one of these placed in each cage as needed. Thus the weevils were provided with normally growing cotton, not with wilted or transplanted cotton.

It was at first planned to ascertain the longevity of *all* the weevils leaving hibernation in the large cages but it was soon found that this would require more work each day than could be done during the daylight hours. We therefore took the weevils

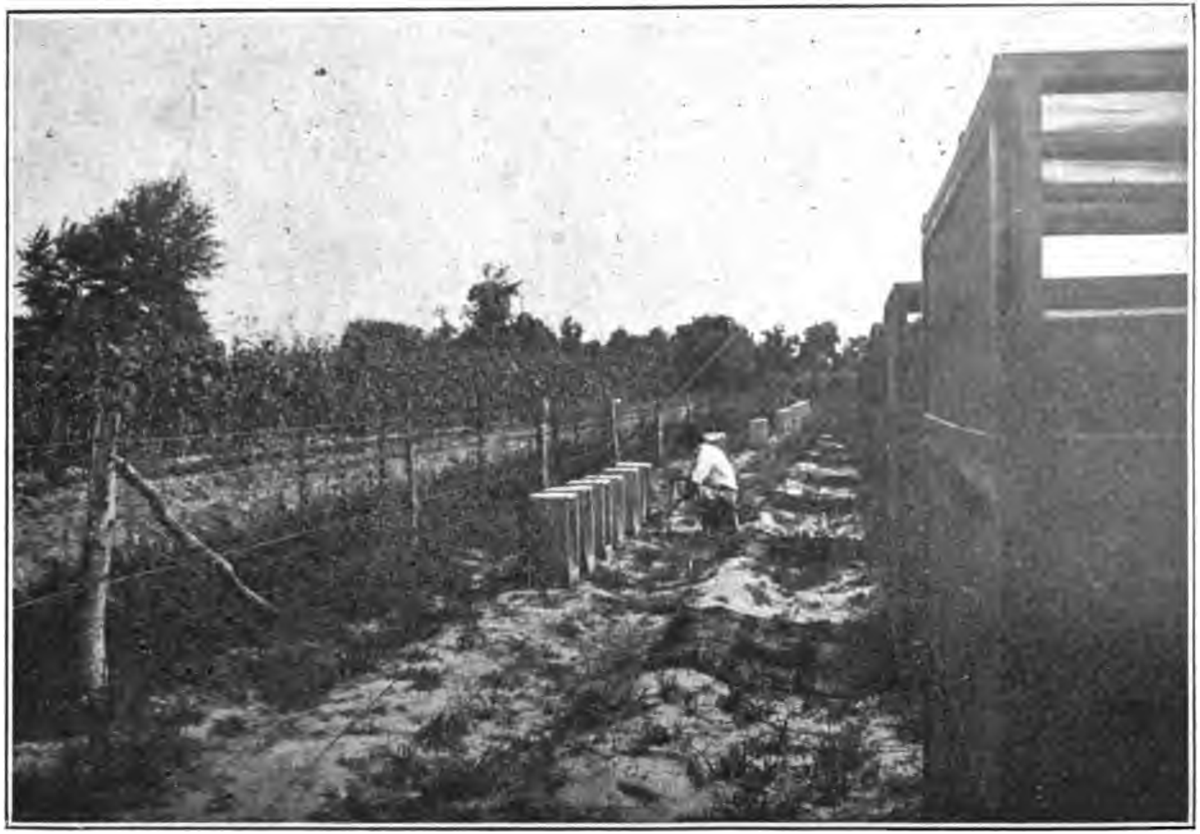

Fig. 6. The ' longevity cages'' at Mansura, in which it was determined how long the boll weevils could live after leaving hibernation in the spring. The small "longevity cages" are seen near the fence. Corners of the large hibernation cages show at the extreme right of the picture. (Original).

which emerged in each cage during two consecutive days of each week and determined their longevity in the small cages.

AVERAGE LENGTH OF LIFE AFTER LEAVING HIBERNATION, ALL WEEVILS.

Observations were made in 67 longevity cages, containing a total of 621 boll weevils which left their hibernating quarters at various dates from February 23 to June 29, 1909. The average time these 621 weevils lived, after leaving hibernation, was 10.7 days. The individual weevil living the longest, after leaving hibernation, was one which emerged from hibernation on March 5th and lived until April 18th, a period of 44 days. The minimum longevity was of course less than 24 hours, some few weevils dying the same day they emerged from hibernation. Thirty-one of the longevity cages were started prior to April 17th and no cotton was available for placing in them. These 31 cages contained 261 weevils and they lived a total of 2,896 "weevil-days,"or an average of 11.09 days each. Thus we may say that weevils emerging prior to April 17th lived an average of 11 days when no cotton could be had for them to feed on. The maximum longevity of these weevils, not provided with growing cotton, was 44 days.

The 36 longevity cages started on and after April 17th all contained growing cotton and all weevils in these cages had cotton to feed on until the day of their death. The average longevity, after leaving winter quarters, of the 360 weevils in these cages was 10.42 days. The maximum longevity was 36 days.

It is interesting to compare the longevity of weevils which emerge from hibernation early in the spring with that of the weevils emerging from hibernation later. This comparison is made easy by the following table, which shows the longevity of weevils emerging at different times during the spring and summer.

TABLE XIII.

LONGEVITY OF BOLL WEEVILS LEAVING HIBERNATION AT DIFFERENT DATES..

Time of leaving hibernation.	Average longevity after leaving hibernation.	Maximum longevity.
March 1-15*	15.7 days	44 days
March 16-31*	7.6 "	22 "
April 1-16*	11.4 "	36 "
April 17-30	10.9 "	36 "
May 1-15	10.3 "	30 "
May 16-31	11.3 "	22 "
June 1-15	7.2 "	16 "
June 16-29	9.5 "	22 "

It is thus seen that as the season advances and the weather grows hotter the life of the weevils after leaving hibernation becomes shorter and shorter.

EFFECT OF FALL DESTRUCTION OF THE COTTON PLANTS ON LONGEVITY OF THE WEEVILS AFTER THEY LEAVE HIBERNATION IN SPRING.

For all practical purposes there is no difference between depriving the weevils of food by destroying the cotton plants at a given date and depriving them of food by gathering them in the cotton fields at a corresponding date and confining them in cages without cotton to feed upon. The length of time the weevils must live without food is the same in both cases and the opportunities afforded the weevils for hibernation in the cages very closely paralleled those available to the weevils remaining in the fields. We have already explained how weevils were gathered and confined in the cages at different dates in the fall of 1908 and how many of each lot survived the winter, as well as the rate at which they emerged from hibernation in the spring of 1909. By keeping separate the weevils from the large hibernation cages, as they emerged, and confining them in the smaller longevity cages, we were enabled to ascertain whether their deprivation of food at different dates in the fall had any effect upon the time they lived after leaving hibernation in the spring. This information is contained in the following table:

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*Weevils not supplied with cotton. All others provided with growing cotton to feed on.

TABLE XIV.

LONGEVITY OF BOLL WEEVILS, AFTER LEAVING HIBERNATION IN SPRING, WHEN DEPRIVED OF FOOD AT DIFFERENT DATES THE PRECEDING AUTUMN.

Date deprived of food, fall of 1908.	Average longevity, after leaving hibernation, spring of 1909.*	Maximum longevity.
Sept. 28 to Oct. 5	10 days	22 days
Oct. 12 to Oct. 19	11 "	20 "
Oct. 26 to Nov. 2	10.9 "	38 "
Nov. 9 to Nov. 16	10.7 "	36 "
Nov. 23 to Nov. 30	7.6 "	26 "
Dec. 7 to Dec. 21	11.6 "	44 "

CHAPTER V.

COMPARISON OF CLIMATOLOGICAL CONDITIONS EXISTING DURING THIS EXPERIMENT WITH THOSE NORMALLY EXISTING IN CENTRAL LOUISIANA.

The value of the results derived from the foregoing experiments can best be gauged by ascertaining whether or not the season in which they were made was an average one. If the season was a normal one from the standpoint of temperature and rainfall the percentage of weevils surviving the winter must have been identical with the percentage normally living through the winter in the central part of the State.

TEMPERATURE.

A comparison of the temperatures prevailing at Mansura, during the period covered by this experiment, with the temperatures normally prevailing there at the same seasons cannot be made. for temperature records were not kept at Mansura in previous years. The only comparison that can be made is with the temperature recorded at the nearest U. S. Weather Bureau Station, which in this case is Alexandria, about 30 miles north-

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*This table includes the weevils that emerged from hibernation prior to April 17th, which received no food, as well as those which emerged after that date and which were provided with growing cotton in the longevity cages.

west of Mansura. As any marked change in temperature invariably occurs over a large area such a comparison possesses considerable value. In the following table we give the monthly mean temperatures at Mansura, as recorded by our own instruments, and the means for the same months as recorded at Alexandria by Miss Estelle Graham, observer for the Weather Bureau at that point. The departure from normal (average) temperature at Alexandria is also given.

TABLE XV.

COMPARISON OF MONTHLY MEAN TEMPERATURES AT MANSURA AND ALEXANDRIA, LA., WITH NORMAL MONTHLY TEMPERATURES.

Month.	Mean temperatures at Mansura, degrees F., as recorded by instruments of the Crop Pest Commission.	Mean temperatures at Alexandria, from records of U. S. Weather Bureau.	Departure from normal mean temperature at Alexandria, from records of U. S. Weather Bureau.
Oct., 1908	62.2°	62.2°	—4.2°
Nov., 1908	59.6°	59.2°	+2.0°
Dec., 1908	56.1°	54°	+4.4°
Jan., 1909	55.2°	52.8°	+3.7°
Feb., 1909	54.8°	52.2°	+2.3°
March, 1909	63.5°	60°	—0.2°
April, 1909	69.2°	66.2°	—0.7°
May, 1909	72.8°	71.2°	—2.5°
June, 1909	80.6°	80.8°	+1.2°

From this table we see that the average temperatures prevailing at Alexandria from September until July were very nearly the same, the difference in the monthly mean at the two places being in no case more than 3½ degrees and in most months less than 3 degrees. It is therefore likely that the variation from normal at Alexandria also held good for Mansura, although there is no way of verifying this with certainty.

We see that the temperature at Alexandria during what may be termed the "winter hibernating period" (November to February, inclusive) was slightly above the normal. We might therefore be justified in supposing that the normal winter would be survived by a slightly smaller percentage of the weevils, though an average difference of 3.1 degrees in temperature could hardly be expected to materially increase the winter mortality among the insects.

During March and April the mean temperature varied from the normal less than 1 degree. Hence we may safely conclude that the rate of emergence from hibernation during March and April was normal in every respect and the same emergence may be expected in Central Louisiana during every March and April of normal mean temperature.

During May the temperature was 2½ degrees below normal, which may warrant the assumption that in the average season the weevils would emerge from hibernation somewhat more rapidly during May than they did in this experiment. This slight advantage is offset, however, by the fact that the temperature prevailing during June was 1.2 degrees above normal. In the normal season this month would have a temperature averaging 1.2 degrees lower. We could therefore ordinarily expect a slower emergence from hibernation during June than took place in this experiment, with the result that a larger proportion of the boll weevils would remain in hibernation longer and emerge later in June than they did this year.

PRECIPITATION.

As in the case of the temperatures a strict comparison of the rainfall at Mansura with the normal, or average, rainfall cannot be made owing to the absence of any previous records. While a comparison of the temperatures prevailing at Mansura and Alexandria affords reliable information, any attempted comparison of the rainfall at the two places is much less satisfactory. Unlike changes in temperature, rains and thunderstorms are frequently more or less local in character and there is no assurance that the rainfall is even approximately the same at points only a few miles apart. As a matter of general interest however, the rainfall at Mansura during the time of the experiment can be compared with that of Alexandria, and the latter compared with the normal for whatever it may be worth.

At Mansura during the winter, that is, from December 8, 1908, to March 1, 1909, the rainfall was 8.07 inches. At Alexandria during the same period it was 7.72 inches.

From March 1 to June 29, 1909, the time during which the bulk of the over-wintered weevils were emerging from hibernation, the rainfall at Mansura was 20.63 inches and at Alexandria 18.22 inches.*

The rainfall at Alexandria was 3.21 inches below normal during December, 4.15 below during January, 0.36 below during February and 2.65 below normal during March. From December 1st to April 1st, the rainfall at Alexandria was therefore 10.37 inches less than the average during this period of the year. Owing to the short distance separating Mansura and Alexandria and the similarity in the *actual* rainfall at the two places, December to March, it seems likely that a similar deficiency in the winter rainfall existed at Mansura. In other words, the winter at Mansura was an exceptionally dry one, though not far from normal so far as the temperature was concerned. That dry winters are survived by an exceptionally large number of boll weevils has been observed in a general way for several years. We have no doubt that the percentage (20.63) of the weevils which hibernated successfully at Mansura the past winter was above the average. How much above will doubtless be revealed by the observations to be made the coming winter.

The rainfall at Alexandria was 0.37 inches below normal during April,† 1.93 inches above normal during May and 0.39 inches below normal during June. The period (including March) during which the bulk of the weevils were emerging from hibernation showed a deficiency of 1.48 inches, a variation from the normal hardly sufficient to influence the rate of emergence from hibernation.

We conclude that the number of weevils living through the past winter in Central Louisiana was above the average. The rate of emergence from hibernation was normal, and approximately the same rate of emergence from hibernation may be expected in every spring of average temperature and rainfall.

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*Records of the precipitation at Alexandria taken from the Monthly Reports of the U. S. Weather Bureau, Louisiana Section.

†To Dr. I. M. Cline, Director of the Louisiana Section, U. S. Weather Bureau, we are indebted for the records of normal monthly precipitation at Alexandria.

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CIRCULAR NO. 32

OF THE

State Crop Pest Commission

OF

LOUISIANA

THE STATE CROP PEST LAW OF LOUISIANA

—AND—

Rules and Regulations of the State Crop Pest Commission,
In Effect November 1, 1909.

ISSUED UNDER THE DIRECTION OF THE
STATE BOARD OF AGRICULTURE AND IMMIGRATION.
CHAS. SCHULER, Commissioner.

Independent Printing Co.
Baton Rouge, La.

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tateCrop Pest Commission

OF LOUISIANA.

CIRCULAR No. 32. November 1, 1909.

The Circulars of the State Crop Pest Commission are sent free of rge to all farmers and fruit growers of Louisiana who make applica- therefor.

THE STATE CROP PEST LAW OF LOUISIANA

AND

LES AND REGULATIONS OF THE STATE CROP PEST COMMISSION, IN EFFECT NOVEMBER 1, 1909.

INTRODUCTORY.

To meet a growing demand for information concerning the s and regulations of the State which have to do with pre- ting the dissemination of injurious insects and plant diseases, d to furnish nurserymen, transportation officials and express nts with a manual for ready reference, it has been deemed ad- ble to publish in pamphlet form all of the regulations of the p Pest Commission now in force.

Fruit growers and farmers, as well as all business interests endent directly or indirectly upon the argricultural resources the State, are realizing more and more the necessity of pre- ting the unrestricted distribution of pests which, in seasons rable to their rapid increase, often destroy the greater por- , or occasionally all, of some important crop

The need for such protection for the staple crops and fruits the State has made itself felt in the increased demands made n the State Crop Pest Commission, with the result that the mmission's regulations now deal not only with the boll weevil, with the San Jose scale, sugar-cane borer and the Texas fever le tick, as well as with ten dangerous insect and fungous mies of fruits.

Fruit growers particularly should be posted upon the re lations of the Commission, in order that they may avail th selves of the protection offered by the Commission, and in or that they may the better guard against unscrupulous fruit t agents who may attempt to impose upon them with diseas nursery stock.

Although the Regulations of the Commission become eff tive upon their publication in the Official Journal of the Sta the advantage and convenience of having them brought toget in convenient form for ready reference will be self-evident to t many farmers, shippers and others who have occasion to cons them from time to time.

In the present publication, Act. No. 6 of the Extra Sess of 1903 (which created the State Crop Pest Commission and ga it authority to deal with pests inimical to the horticultural a agricultural interests of the State) is first given. Following t Act will be found the regulations of the Commission, arranged the following order:

Insects and Fungous Diseases Declared by the Commissi to be Dangerously Injurious.

General Regulations for the Government of the Entomol gist, Assistants, Inspectors and Other Employees of t Commission.

Regulations Governing the Sale and Shipment of Nurse Stock.

Regulations for Facilitating the Work of Cattle Tick Era cation.

Boll Weevil Quarantine Regulations.

Sugar Cane Borer Quarantine Regulations.

The regulations of the Commission are subject to amen ment from time to time as the Commission may deem necessa or expedient, and the regulations herein given are those in eff at the present date.

WILMON NEWELL,
Secretary.

BATON ROUGE, November 1, 1909.

THE STATE CROP PEST LAW OF LOUISIANA.

AN ACT.

(Act No. 6. House Bill No. 6.—By Mr. Sellers.)

provide for the establishment and organization of a State Crop Pest Commission and to define the duties and powers of the same; to fix penalties for the violation of any of the rules, orders, ordinances and regulations thereof; to make it a misdemeanor for any person, firm or corporation to bring into this State or have in possession, except certain persons, any living Mexican Boll Weevil in any of its stages, and providing a penalty therefor; to provide for the publication and distribution of all the proceedings and recommendations of said Commission; to authorize said Commission to restrain by injunction or otherwise any violations, or threatened violations, of its orders, rules, ordinances and regulations, and to prohibit any court of the State from bonding the same prior to trial on the merits; to make it the duty of the Attorney General and District Attorneys to represent said Commission and the Sheriffs to serve all papers for said Commission; to provide for the payment of all fines and forfeitures for violations of the orders, rules, ordinances and regulations of said Commission to the State Treasurer, and by him to be placed to the credit of said Commission; to relieve said Commission of the necessity of giving bond or security in any legal proceedings which it shall institute or defend in any court of justice in this State; to make an appropriation to carry out the provisions of this Act and to repeal all laws or parts of laws inconsistent or in conflict with the same.

State Crop Pest Commission created.

Members.

Domicile.

Meetings.

Per Diem.

Secretary.

Section 1. Be it enacted by the General Assembly of t State of Louisiana, That a State Crop Pest Commission for t State of Louisiana is hereby created and established, to cons of the Governor as ex-officio chairman, the Commissioner Agriculture, the Director of the State Experiment Station, t Station Entomologist and two experienced resident cotton pla ers, the latter to be appointed by the Governor, and every fo years thereafter, and who shall serve for four years and un their successors are duly appointed and qualified. The Stati Entomologist and the two planters shall be commissioned a shall qualify in the same manner as provided by the Constituti and laws of the State for all other officers. Said Commiss shall have its domicile at Baton Rouge and shall hold its fi session at said place immediately after the promulgation of t Act, and at such other times and places as may be designated said Commission. At any meeting of said Commission any th members shall constitute a quorum to transact business. T members of said Commission, not salaried under the State g ernment, shall receive the sum of five ($5) dollars per day each day consumed in going to and returning from any of t meetings of said Commission, and while in attendance there and necessary traveling expenses, which amount shall be paid the State Treasurer on the voucher of the member, approved the Governor, out of any funds to the credit of said Commissi Said Commission shall elect one of its members secretary, a shall appoint such other assistants as may be necessary to ca on the work of said Commission, and shall fix their compensati

Chairman; his duties.

Sec. 2. Be it further enacted, etc., That for the purpose o carrying out the rules, ordinances, orders and regulations of sai Commission, as hereinafter provided, the Commissioner of Agr culture shall be the active chairman of said Commission, and a such shall see that all the rules, ordinances, orders and regul tions of the same are faithfully executed; and in addition to suc duties, the active chairman shall have the power, during the i terval between the meetings of said Commission, and when th same is not in session, to issue all orders, and to take all necessa steps, by suit or otherwise, to execute the laws of the State on th subject matter delegated to said Commission, and to carry o he rules, ordinances, orders and regulations of said Commission ade thereunder; and he may, in his discretion, call special meetngs of the Commission whenever, in his opinion, an emergency hall require it, provided, that in all cases where two or more embers shall demand the same, it shall be his duty to convene he same in special session.

Power to make and enforce rules to prevent the spread of insects and diseases dangerous to the agricultural interests of the State.

Sec. 3. Be it further enacted, etc., That said Commission hall have full and plenary power to deal with all crop and fruit ests and such contagious and infectious crop and fruit diseases , in the opinion of the Commission, may be prevented. conolled or eradicated; and with full power and authority to make, romulgate and enforce such rules, ordinances, orders and reglations, and to do and perform such acts as, in their judgment, ay be necessary to control, eradicate and prevent the introuction, spread or dissemination of the Mexican Boll Weevil in he State, and all other injurious crop and fruit pests and disases as far as may be possible, and all the rules, ordinances, rders and regulations of said Commission shall have the force nd effect of law so far as they conform to the general laws of he State and the United States. Said Commission, in the exerise of the power and authority hereby delegated, shall have uthority to prohibit the shipment or bringing into this State of ny cotton seed or other article of farm product, or any other rticle of any nature or character whatsoever from any State, erritory or foreign country, or consigned from points within ny State, Territory or foreign country where the boll weevil or ny other infectious or contagious crop or fruit disease exists, exept under such rules and regulations as may be adopted by said ommission.

Making it a misdemeanor to have in possession any living boll weevil, or infested cotton plant or cotton square, boll, etc.

Sec. 4. Be it further enacted, etc., That any firm, person or rporation, except a duly recognized State or Federal entomoloist, who shall bring into this State, or have in possession, for ny purpose, any living Mexican Boll Weevil, cotton boll, square, lant or seed containing the Mexican Boll Weevil, whether adult r in the pupal, larval or egg state, shall be deemed guilty of a isdemeanor, and shall, upon conviction, be fined not less than wenty-five nor more than one thousand dollars for each offense, or be imprisoned for not less than ten days nor more than six months. Prosecutions under the provisions of this section may be instituted and carried on in any parish where any person, firm or corporation may be found with, or shown to have had in possession, any living Mexican Boll Weevil, cotton boll, square, plant or seed containing the Mexican Boll Weevil, whether adult or in the pupal, larval or egg state.

Penalty for violating rules made by the Commission.

Sec. 5. Be it further enacted, etc., That any person, firm or corporation violating any of the rules, ordinances, orders or regulations of said Commission, shall be guilty of a misdemeanor, and shall, upon conviction thereof, be punishable by a fine of not less than twenty-five nor more than one thousand dollars, or imprisonment for not more than six months nor less than thirty days. All prosecutions under this Act shall be commenced and carried on in any parish of the State affected by the violation of said orders, ordinances, rules and regulations, and the said Commission may enjoin any threatened or attempted violations of its rules, orders, ordinances and regulations in any court of competent jurisdiction, or take any other civil proceedings necessary to carry out and enforce the purposes of this Act; and no court of this State shall have the right previous to final trial to set aside said injunction on bond. It shall be the duty of the Attorney General and the various District Attorneys to represent said Commission whenever called on to do so; and said Commission in the discharge and enforcement of the dutes and powers herein delegated, may send for books and papers, swear witnesses, etc.; and it is hereby made the duty of the various Sheriffs throughout the State to serve all papers, summons, etc., that may be delivered to them by said Commission.

Prosecutions, how conducted.

Duty of Attorney General and District Attorneys

Rules, regulations and bulletins to be published and distributed under direction of the Louisiana State Board of Agriculture and Immigration.

Sec. 6. Be it further enacted, etc., That said Commission at their first session shall prepare and publish a list of dangerous crop and fruit pests, and infectious and contagious plant diseases, known or suspected to be present within the State or liable to be introduced, and may at any subsequent meeting extend or amend said list. The Commission shall also publish methods for exterminating such pests or infectious diseases as they may deem capable of being exterminated within the boundaries of the

State, and for suppressing such as cannot be exterminated, and for preventing the spread of such pests or diseases within the State; and for the purpose of disseminating knowledge concerning contagious diseases or injurious pests affecting crops, plants, trees, etc., and the remedies, preventives and disinfectants applicable thereto, the Commission shall from time to time, as they may deem necessary, have printed and distributed bulletins containing such information, remedies, preventives and disinfectants as they may approve, including also the rules, orders, ordinances and regulation of said Commission, which said culletins shall be printed and distributed to all interested persons under the direction and supervision of the Louisiana State Board of Agriculture and Immigration. When the said Commission has reason to suspect that any pest or plant disease listed by them as dangerous, exists in any parish of the State, they shall cause such suspicion to be verified by a person competent to determine the specific identity of such crop pests or disease of plant, and if such suspicion prove well founded, the inspector of said Commission shall immediately take charge of said infected property and adopt such measures for the treatment or extermnation of same as the Commission may direct. Any duly authorized agent of the Commission shall have authority to inspect any building, warehouse, depot, or place where any property is located, or premises or field supposed to be infested by any crop pest or disease, listed and published as such by the said Commission, and if, in the opinion of the Entomologist selected by said Commission, it shall be necessary to destroy the property so infested so as to prevent the further spread of said injurious crop pest or disease, he shall have authority to destroy said property, and the Commission shall have the right to fix a compensation to be awarded the owner thereof. If the owner should be dissatisfied with the amount allowed by said Commission as compensation for the property destroyed, he shall have the right to appeal to the court of the parish in which such property is destroyed, but in no case shall any contest as to the value of the property to be destroyed suspend action by the Commission in enforcing their rules, orders, ordinances and regulations. Any one who shall seek to prevent any

Authority to make inspections and to destroy infested or infected property.

Compensation for property destroyed.

Right of appeal by owner of destroyed property.

Penalty for interfering with agents of Commission in discharge of their duty.

inspection under the direction of said Commission, or who shall otherwise interfere with the agents or employees of said Commission while in the performance of their duties, shall, upon conviction, be fined not less than twenty-five dollars nor more than five hundred dollars for each offense, or may be imprisoned for not less than ten nor more than thirty days. Prosecution under the provisions of this section shall be instituted in any parish of the State in which the offense is committed.

Collected fines to be paid into the State Treasury.

Sec. 7. Be it further enacted, etc., That all fines collected from prosecutions under the provision of this Act shall be paid to the State Treasurer and by him placed to the credit of said Commission.

Commission exempted from giving bond.

Sec. 8. Be it further enacted, etc., That said Commission shall not be required to give any bond or security in any legal proceedings which it shall institute or defend in any court of justice in this State.

Appropriations.

Sec. 9. Be it further enacted, etc. That for the purpose of carrying out the provisions of this Act the sum of $25,000, or so much thereof as may be necessary, is hereby appropriated, out of any funds in the Treasury not otherwise appropriated, and shall be paid by the State Treasurer upon properly authenticated vouchers signed by the president or secretary of said Commission.

Sec. 10. Be it further enacted, etc., That all laws or parts of laws in conflict or inconsistent with this Act, be and the same are hereby repealed.

J. Y. SANDERS,
Speaker of the House of Representatives.
H. C. CAGE,
President pro tem. of the Senate.

Approved December 15, A. D. 1903.

W. W. HEARD.
Governor of the State of Louisiana.

A true copy:
JOHN T. MICHEL,
Secretary of State.

REGULATIONS OF THE STATE CROP PEST COMMISSION,

IN EFFECT ON NOVEMBER 1, 1909.

Adopted and Promulgated by the Commission in Accordance with the Foregoing Act of the State Legislature.

INSECT PESTS AND FUNGOUS DISEASES DECLARED BY THE COMMISSION TO BE DANGEROUSLY INJURIOUS.

SECTION I.*

Insects and diseases declared dangerously injurious.

Be it declared, ordained and ordered, that the following insects and diseases are hereby declared to be dangerous crop and fruit pests:

(*a*) The boll weevil (*Anthonomus grandis*).
(*b*) The Texas fever cattle tick (*Margaropus annulatus*).
(*c*) The San Jose scale (*Aspidiotus perniciosus*).
(*d*) Nematode root knot (*Heterodera radicicola*).
(*e*) The cottony cushion scale (*Icerya purchasi*).
(*f*) The West Indian peach scale (*Aulacaspis pentagona*).
(*g*) The woolly aphis (*Schizoneura lanigera*).
(*h*) The white fly (*Aleyrodes citri*).
(*i*) The chaff scale (*Paralatoria pergandei*).
(*j*) The Morelos orange fruit worm (*Trypeta ludens*).
(*k*) The sugar-cane borer (*Diatraea saccharalis*).
(*l*) Crown gall; hairy root disease.
(*m*) Black knot.

Provided, however, that this Commission may, from time to time, declare other fruit and crop pests or diseases to be dangerous.

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*As amended by the Commission April 11, 1907, and Oct. 19, 1908.

GENERAL REGULATIONS RELATIVE TO ENTOMOLOGIST, ASSISTANTS, INSPECTORS, ETC.

SECTION II.†

Entomologist: duties of.

Be it further declared, ordained and ordered that the Experiment Station Entomologist shall be the Entomologist of this Commission; and it is hereby made his duty, with the assistance of the inspectors hereafter provided for, to carry out and enforce the provisions of Act No. 6 of the Extra Session of the Legislature of the State of Louisiana, approved December 15, 1903. In the enforcement of the said Act of the Legislature he shall have the right, and it is hereby made his duty, whenever the public exigencies require it, to prevent the bringing into o carrying through the State of Louisiana of any of the property, articles or things hereby quarantined against, and to condemn and cause the same to be destroyed, as well as to condemn and cause to be destroyed all other property, premises or fields in this State infested with any seriously injurious insect or disease.

SECTION III.†

District Attorneys: their duty to assist Commission.

The District Attorneys throughout the State are hereby especially enjoined to aid and assist this Commission in carrying out the provisions of Act No. 6 of the Extra Session of the Legislature of this State, approved December 15, 1903, as i made their duty by Section 5 of said Act.

SECTION IV.†

Assistant Entomologists; their duties, etc

Be it further declared, ordained and ordered that, in addi tion to the Entomologist of this Commission, the Executiv Committee of this Commission may, and is hereby given powe and authority to appoint necessary assistant entomologists, wh shall perform such duties as may be assigned to them by the En tomologist of this Commission, and who shall be under hi supervision and control and shall be subject to removal or dis missal by the Executive Committee of this Commission whe ever, in its opinion, it may deem advisable to dispense with thei services; such assistant entomologists shall receive and be pai such a salary as may be fixed by the Executive Committee, pa able by the State Treasurer on the voucher of the Secretary of this Commission, approved by the Governor, out of any funds to the credit of the Commission.

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†As amended and adopted by the Commission at its meeting, No vember 7, 1905.

SECTION V.†

Inspectors: appointments of, their duties, etc.

Be it further declared, ordained and ordered that as many inspectors as may be necessary be appointed by the Executive Committee of this Commission; such inspectors shall perform their duties under the direct supervision and control of the Entomologist of this Commission. Each inspector shall receive such a salary for his services as the Executive Committee may fix, payable monthly by the State Treasurer out of any funds to the credit of said Commission, on the voucher of the Secretary of the Commission, approved by the Governor. Inspectors shall be liable to removal or dismissal by the Entomologist of this Commission whenever, in his opinion, it may be advisable to dismiss or remove them. It is hereby made their duty to prevent the bringing into or through the State of Louisiana of any of the articles, property or things hereby quarantined against, and to prevent the shipment or removal from any infested place in this State, to any place in this State not infested, of any of the articles, property or things which it is hereby declared shall not be removed; and, acting under the authority and control of the Entomologist of this Commission, and whenever deemed necessary by him, to destroy any and all such property, as well as any and all growing crops, fields, premises and other property which may be infested with any seriously injurious insect or disease. It is hereby further made their duty to cause the arrest of any and all persons guilty of violating any of the rules, orders or regulations of this Commission, as well as any of the provisions of Act No. 6 of the Extra Session of the Legislature of the State of Louisiana, approved December 15, 1903.

SECTION VI.†

Payment for confiscated property.

Be it further declared, ordained and ordered that compensation, when paid for property destroyed, shall be fixed by this Commission in the manner provided by Section 6 of Act No. 6 of the Acts of the Legislature of this State, approved December 15, 1903.

REGULATIONS GOVERNING THE SALE AND SHIPMENT OF FRUIT TREES AND OTHER NURSERY STOCK.

SECTION VII.*

Sale, shipment or delivery of infested trees or plants prohibited.

No firm, person or corporation shall sell, ship, exchange, deliver or give away, within the State of Louisiana, any trees, vines, shrubs, buds, cuttings or plants, or parts of plants, infested with the San Jose scale, nematode root knot, cottony cushion scale, chaff scale, West Indian peach scale or white fly, or infected with crown gall, hairy root disease or black knot.

SECTION VIII.†

Shipments of nursery stock from other States; must bear inspection certificate.

(*a*) All nursery stock shipped into this State from any other State or country shall be prominently labeled with a certificate of inspection signed by the State Entomologist, or other duly authorized official, of the state or country in which said stock was grown. All common carriers and their agents are hereby forbidden to deliver at any point in this State any shipment of nursery stock not labeled with a valid and unexpired certificate of inspection, signed either by the Secretary of the Crop Pest Commission of Louisiana or by the State Entomologist or other duly authorized official of the State or country where such stock was grown. Shipments not so labeled shall be liable to confiscation upon the order of the Entomologist of the Crop Pest Commission.

Transportation companies: must notify Secretary on arrival of uncertified shipments of nursery stock.

(*b*) Transportation companies and their agents shall immediately notify the Secretary of the Crop Pest Commission (Baton Rouge, Louisiana), when by oversight, negligence or otherwise, any shipment of nursery stock, without a proper certificate attached, shall arrive at any station or wharf in this State, and it shall be the duty of the Secretary to proceed as speedily as possible, by himself or his assistant, to investigate and dispose of such shipment.

Entomologists and assistants: have authority to inspect shipments; also to confiscate infested shipments.

(*c*) The Entomologist and his assistants shall have authority to inspect any shipment of nursery stock at any station or wharf in this State, and shall have authority to stop any nursery stock when in transit, for the purpose of inspecting the same, regardless of whether such stock shall bear a certificate of inspection or not. The Entomologist shall have authority to seize, condemn and destroy any nursery stock infested with San Jose scale or other seriously injurious insect or disease, found within the confines of this State.

SECTION IX.†

Nurserymen: must apply for inspection before July 1st of each year; must attach certificates to shipments and deliveries.

Each and every person, firm or corporation growing nursery stock for sale in this State shall apply to the Secretary of the Crop Pest Commission for inspection on or before July 1 of each year. It shall be the duty of the Secretary to inspect such nursery not later than November 1. If upon such inspection the nursery stock and premises be found apparently free from the San Jose scale and other seriously injurious insects and plant diseases, a certificate shall be given to that effect. On and after August 1, 1905, a copy of said certificate, bearing the seal of the State Crop Pest Commission and the *fac-simile* signature of the Secretary, shall be attached to each and every box, bundle and package of nursery stock shipped within the State. Shipments of nursery stock not so labeled shall be refused for shipment by all common carriers and their agents, and such stock, if found in transit or in the possession of any common carrier by the Entomologist or his assistants, shall be liable to confiscation.

Transportation companies: must refuse to accept uncertificated shipments of nursery stock.

SECTION X.†

Sale, shipment, delivery or gift of uncertificated nursery stock prohibited.

No firm, person or corporation shall sell, give away, exchange or deliver, within this State, any trees, vines, shrubs, or plants, commonly known as nursery stock, without same having attached thereto in a prominent manner, a copy of the certificate of inspection signed by the Secretary of the State Crop Pest Commission, or by the State Entomologist, or other duly authorized official of the State or country in which said nursery stock was grown.

SECTION XI.†

Fumigation of trees, etc.; when required.

The Entomologist of the Commission shall have power to require any one in the State to fumigate his trees, shrubs or plants with hydrocyanic acid gas or other substance when, in his judgment, such treatment is necessary or advisable for the proper protection of the agricultural or horticultural interests of the State, or of any section thereof.

SECTION XII.**

Orange fruit worm: sale of infested fruit prohibited.

The sale, or offering for sale, within this State, of any oranges, sweet limes or other fruits infested with the Morelos orange fruit worm, is hereby forbidden. Any fruit, infested with this pest, found exposed for sale or in the possession of any firm, corporation, common carrier, dealer, agent or person within the confines of this State, by any inspector of the State Crop Pest Commission, shall be immediately seized by him and destroyed by burning. Violations of this section shall be punished as provided by Section 5 of Act No. 6 of the Extra Session of 1903.

Violations: how punished.

REGULATIONS FOR FACILITATING ERADICATION OF THE TEXAS FEVER CATTLE TICK IN LINCOLN AND CLAIBORNE PARISHES.

SECTION XIII.§

Movement of cattle into Lincoln and Claiborne Parishes, from tick-infested territory; prohibited.

No cattle shall be driven, transported or allowed to stray into Lincoln or Claiborne parishes from any territory declared to be infested with the Texas fever cattle tick (*Margaropus annulatus*), except as hereinafter provided for.

**Adopted by the Executive Committee August 29, 1906; ratified by the entire Commission at its meeting April 11, 1907.

§Adopted by authority of the Commission, May 22, 1907 Effective on and after July 1, 1907.

SECTION XIV.§

All territory declared by the United States Department of Agriculture as infested with the catle tick shall be considered and declared by this Commission as infested, as applied to the interpretation of Section XIII above.

Infested territory; defined.

SECTION XV.§

The annual regulations and amendments thereto of the United States Department of Agriculture for the regulation of interstate transportation of cattle infested with the Texas fever cattle tick, are adopted as a portion of these regulaions.

Annual Regulations of Dept. of Agriculture; made a part of these Regulations.

SECTION XVI.§

Cattle originating outside of Lincoln and Claiborne parishes may be admitted into these parishes upon a certificate from a duly authorized inspector of this Commission, or of the Bureau of Animal Industry of the United States Department of Agriculture, that such cattle originated in tick-free territory and have not been exposed to tick infestation during transportation; or infested cattle may be shipped to any regular railroad station in these parishes, provided the inspector of this Commission is duly notified before such cattle are unloaded from cars, or removed from railroad pens, and the unloading and disinfection of said cattle is conducted in accordance with the stipulations of said inspector; that said inspector shall personally supervise the dipping or disinfection of all infested cattle for the destruction of ticks.

Movement of cattle into Lincoln or Claiborne Parishes; may be admitted on certificate of inspector.

Infested cattle may be shipped into Parish under supervision of Inspector.

Railroad Co.; must notify inspector before removal of cattle from cars or unloading pens.

SECTION XVII.§

Any person or persons, company or corporation bringing, or allowing to be brought, cattle into Lincoln or Claiborne parishes, except as provided for in these regulations, shall be declared guilty of violating the orders of this Commission, and shall be punished as provided for by law.

Violation of regulations; penalty.

SECTION XVIII.§

Cattle, undressed carcasses and green hides thereof, infested with the Texas fever cattle tick, shall not be allowed on the pub-

Cattle, carcasses, green hides infested by cattle tick; not allowed on public roads of Lincoln or Claiborne Parish.

lic roads or moved or allowed to be moved on boat, rail or conveyance from the premises of one party to the premises of another party until they are properly disinfected or declared free of cattle ticks by a representative of this Commission. **Green hides twenty days old shall be considered free of ticks.**

SECTION XIX.§

Cattle, carcasses, etc.; shall not be moved from infested places to non-infested places, or to areas where eradication work is proceeding.

No cattle, carcasses or green hides infested with the Texas fever cattle tick shall be moved or allowed to be moved or go from any field or lot infested with the Texas fever cattle tick to a field or lot where the tick has been eradicated or where eradication is being undertaken under the advice and supervision of the representatives of this Commission.

SECTION XX.§

Inspectors; required to assist owners of cattle in eradicating ticks.

As a means of protecting and assisting the live stock owners and farmers of Lincoln and Claiborne parishes it shall be the duty and privilege of duly authorized appointees of this Commission to visit all premises in the above-named parishes and determine and specify all premises that are found free of the Texas fever cattle tick and such as are infested with said tick; and as a further protection and assistance to the live stock owners and farmers of the above-named parishes it shall be the duty and privilege of appointees of this Commission to devise and direct such means as may be best suited to local conditions for disinfecting cattle and premises found infested with Texas fever cattle ticks.

SECTION XXI.§

Tick-free cattle may be moved on public roads under permit of inspector.

As soon as the cattle tick has been eradicated from the public roads of all or any portion of Lincoln and Claiborne parishes, and this fact is announced by a representative of this Commission, the inspectors of the Commission shall issue permits for the movement of cattle not infested with the cattle tick on these roads from one portion of non-infested territory to another portion of the non-infested territory, provided such cattle shall not be allowed at any time to come into territory infested with the cattle tick or come in contact with cattle infested with the cattle tick. In case cattle are being removed under permit and become infested with the cattle tick, in violation of the purpose of these regulations, said cattle shall be put in quarantine by the inspector of this Commission, and shall be moved only under his permit and direction. Any party or parties, company or corportation driving or transporting, or allowing to be driven or transported, any cattle, carcasses or green hides, except as provided for by these regulations, shall be declared guilty of violating the regulations of this commission, and shall be punished accordingly, as provided for in the law establishing this Commission.

Regulations Pertaining to the Boll Weevil.

SECTION XXII.[†]

Having live boll weevils in possession in uninfested portion of State; prohibited.

Be it further declared, ordained and ordered that no person, firm or corporation, except a duly authorized State or Federal Entomologist, shall bring into or have in his possession, in the uninfested portion of the State of Louisiana, for any purpose whatever, any living boll weevil or cotton boll, square, plant or seed containing the boll weevil, whether adult or in the pupal, larval or egg stage; and any such person, firm or corporation violating this provision of the Act of the Legislature shall, on conviction, as prescribed by Section 4 of Act No. 6 of the Extra Session of the Legislature, approved December 15, 1903, be fined not less than twenty-five dollars, nor more than one thousand dollars for each offense, or imprisoned for not less than ten days, nor more than six months.

Penalty for; fine or imprisonment.

Regulations Pertaining to the Sugar Cane Borer.[‡]

Parishes infested with sugar cane borer.

Whereas, the Sugar Cane Borer (*Diatraea saccharalis*), a dangerously injurious insect enemy of sugar cane, is known to occur in the Parishes of West Baton Rouge, East Baton Rouge nd in all parishes bordering upon the Mississippi River from aton Rouge to Quarantine, as well as in the Parishes of St. artin, Lafayette, Acadia, Vermilion, Iberia, St. Mary, Assumpon, Lafourche and Terrebonne, and in the southern portions of e Parishes of Point Coupee and St. Landry, and

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[‡] Adopted by authority of the Commission, October 19, 1908.

Police Jury of Avoyelles Parish requested quarantine.

Whereas, the Policy Jury of Avoyelles Parish has, through it President, requested the State Crop Pest Commission to estab lish a quarantine to prevent the introduction of said cane bore into the Parish of Avoyelles, therefore,

No sugar cane shall be shipped from defined infested territory.

Be it resolved, and hereby ordered, in accordance with th provisions of Act No. 6 of the Extra Session of 1903, that n sugar cane shall be shipped or transported into the Parish o Avoyelles from the following described territory:

All that portion of the State of Louisiana south of a lin drawn as follows: Starting at the mouth of Natalbany River o Lake Maurepas and proceeding north on the Livingston-Tangipahoa parish line to St. Helena Parish, thence west along the Livingston-St. Helena Parish line to East Baton Rouge Parish thence northeast along the East Baton Rouge-St. Helena Paris line to East Feliciana Parish, thence west along the East Bato Rouge-East Feliciana Parish line to the Mississippi River, thenc up the Mississippi River to Raccourci Landing, thence t Batchelor, Point Coupee Parish, thence in an air line to Melville, St. Landry Parish, thence southwest to Washington, thenc northwest to Ville Platte, St. Landry Parish, thence due wes to the St. Landry-Calcasieu Parish line, thence south along th parish line between Acadia, St. Landry and Calcasieu Parishes t the Mermentau River, thence down the Mermentau River to th Gulf of Mexico.

Requirements to be complied with by steamboat companies.

Steamboats operating on the Mississippi River shall refus to accept for shipment to any point in Avoyelles Parish, all shipments of sugar cane originating below Raccourci Landing on th west bank or below Bayou Sara on the east bank.

Steamboats operating on the Atchafalaya River shall refus to accept for shipment to any point in Avoyelles Parish, all shipments of sugar cane originating below Melville.

Shipments of sugar cane on L. R. & N. and Y. & M. V. Rys.

The L. R. & N. Co. and the Y. & M. V. Ry. Co. shall refus all shipments of sugar cane, intended for any point in Avoyelle Parish, originating at, or south of, Angola and Slaughter, respectively.

T. & P. Ry. shipments.

The T. & P. Ry. Co. shall refuse all shipments of sugar can intended for any point in Avoyelles Parish, originating south o Batchelor on the Port Allen Branch and south of Melville on th Main Line, Louisiana Division.

O. G. & N. E. and S. P. Ry. shipments.

The O. G. & N. E. and the S. P. Ry. Co.'s shall refuse a shipments of sugar cane, intended for any point in Avoyell Parish, originating south of Melville and Washington, respectively.

24

CIRCULAR No. 33

OF THE

State Crop Pest Commission

OF

LOUISIANA

EXPERIMENTS WITH

Powdered Arsenate of Lead

AS A

Practical Boll Weevil Poison

By Wilmon Newell and G. D. Smith

ISSUED UNDER THE DIRECTION OF THE

State Board of Agriculture and Immigration

Chas. Schuler, Commissioner.

BATON ROUGE
The New Advocate, Official Journal
1909

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DO NOT JUMP AT THE CONCLUSION THAT YOU CAN POISON THE BOLL WEEVIL SUCCESSFULLY; STUDY THE CONTENTS OF THIS BULLETIN CAREFULLY, BE SURE YOU UNDERSTAND THE PRINCIPLES UPON WHICH SUCCESSFUL POISONING OF THE WEEVIL IS BASED AND THEN PROCEED CAREFULLY.

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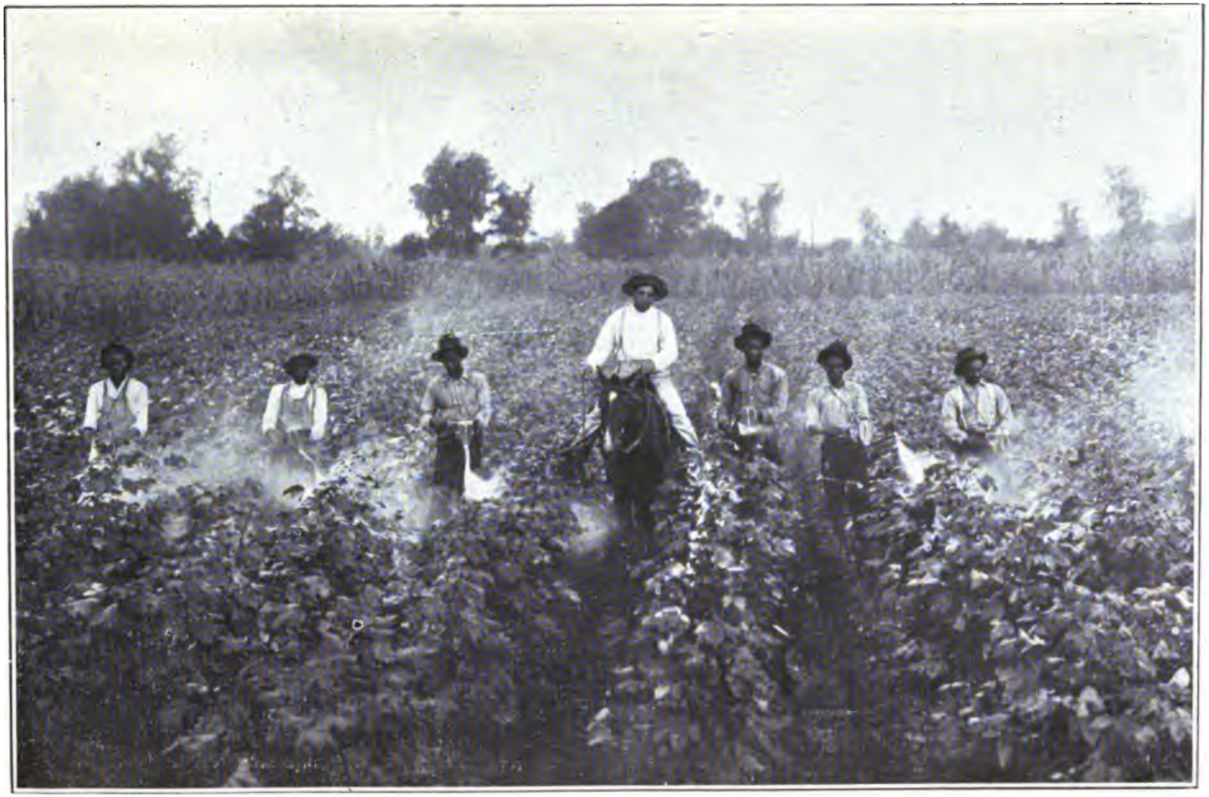

FIG. 1.—Applying the powdered arsenate of lead to 30 acres of cotton per day. The work must be done with machines which force the powder into the terminal buds with a powerful blast of air. Close attention must be given to the hands when negroes are employed. (Original.)

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STATE CROP PEST COMMISSION

OF LOUISIANA.

CIRCULAR No. 33. DECEMBER 1, 1909

The Circulars of the State Crop Pest Commission are sent free of charge to all farmers and fruit growers of Louisiana who make application therefor.

Experiments with Powdered Arsenate of Lead as a Practical Boll Weevil Poison.

By WILMON NEWELL and G. D. SMITH.

It is with gratification that we are able to report material progress, during the past season, in the methods of fighting the boll weevil. It has long been realized that the conditions in Louisiana are so favorable to the boll weevil that the use of cultural methods by themselves cannot insure a profitable cotton crop. Both planters and entomologists have fully appreciated the need of some direct means of destroying the weevils themselves. In the fall of the year this is effectually accomplished by the early fall destruction of all cotton plants.* If thoroughly done, at the right time, and in unison over large areas, there is no doubt whatever but that early fall destruction of the cotton plants would fully solve the weevil problem, but under conditions as they actually exist the early fall destruction of the plants is never thoroughly carried out. The result is that sufficient weevils always survive the winter to seriously menace the following year's crop. Some means of destroying the weevils in spring, as well as in the fall, is therefore imperatively needed.

That we have succeeded in destroying boll weevils in the spring, with profit, will be fully borne out by the experiments with powdered arsenate of lead, detailed on subsequent pages of this Circular. The fact that the cotton treated with this insecticide, in all of our experiments, produced an average of 71 per cent more than similar cotton not treated with it, is sufficient in itself to show that the subject merits more than a passing glance.

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*See Circulars 28, 30 and 31 of the Crop Pest Commission.

We have not been able to produce a full crop by the use of the powdered arsenate of lead, nor have all our experiments shown a profit from its use. In conducting a large number of experiments, made in different ways, it was to be expected that some would be failures. The few failures do not in the least detract from the importance and reliability of the results shown in the experiments which were successful.

In the fact that we have poisoned the over-wintered boll weevils with a definite profit, we find reason for believing that a most decided step forward has been taken in the fight against this pest. Never before has the boll weevil been poisoned with profit. There are many individuals who claim to have made a success of poisoning the weevil, but they have always failed to produce tangible proof of their success by giving the exact areas and productions of poisoned and non-poisoned fields in comparison. In fact, those whose claims in this direction have been the most insistent have been very careful to submit, as evidence of their success, nothing more tangible than "opinions" and "testimonials." Plain facts and figures, unassailable, have been lamentably lacking and the claims made for Paris green, London purple and several other poisons have in most cases been largely inspired by the desire for personal gain on the part of their respective advocates.

In spite of the gratifying results shown by some of our experiments with powdered arsenate of lead we would caution the planter against over-enthusiasm in its use. It cannot solve the boll weevil problem, nor can it insure a full crop. It can be used only as an adjunct to the highly intensive cultural methods, and even then it cannot prove of value except in the hands of careful, painstaking planters who study with care the experiments herein described. It is likely that nine planters, out of every ten, will fail in the use of the powdered arsenate at the first attempt, simply because of failure to apply it at the time, in the manner or in the amount recommended. Arsenate applied by dusting from a sack, for example, cannot result otherwise than in failure. The principles upon which success in poisoning the weevil are based must be thoroughly understood by the planter. He must likewise see that the field work is in exact accord with these principles and thoroughly and carefully done. In the hands of the careful farmer there is no reason why the use of the arsenate should not do what it has done in several of our own experiments—approximately double the crop. On the other hand, we cannot expect it to make a crop under conditions where a crop without it would be impossible.

PRELIMINARY EXPERIMENTS.

In Circular 23,* issued July, 1908, we outlined in detail the various experiments with Paris green and other poisons, which led to the attempt to develop a poison adapted to conditions confronting us when trying to poison the over-wintered weevils. Powdered arsenate of lead was the poison developed and the first experiments with it, made in cages, were sufficiently encouraging to justify careful tests of it in the field. These cage experiments were fully described in Circular 23, which the reader should secure and study as a preliminary to a correct understanding of the present Circular.

Immediately following the cage experiments with powdered arsenate of lead, made in the spring of 1908, arrangements were made for field tests with it. Small fields of cotton in a number of different localities were treated with the poison in the spring and early summer of 1908. Most of these were, unfortunately. located in the Red River Valley and all of these were destroyed by the disastrous overflow of Red River during the summer of 1908. In the case of an experiment located on upland, the tenant became alarmed at the abundance of weevils and plowed up the entire experiment in June. In still another experiment an unfortunate misunderstanding occurred as to the boundaries of the plats, with the result that the weights of the cotton picked from poisoned and non-poisoned plats were not correctly kept. The only field experiment which escaped the series of misfortunes during 1908 was one carried out by Mr. A. R. Roach, of Mansfield. Mr. Roach's experiment is described below.

Though we were more successful in 1909, misfortune did not desert us entirely. Our most extensive series of tests with the powdered arsenate was arranged for at Lakeland, Point Coupee Parish. An excellent stand of cotton was secured, but a local hailstorm on April 30th beat the tender plants to pieces and almost annihilated the experiment. Through the careful attention of Messrs. Phillips Bros., on whose plantation the experiments were located, the cotton largely recovered from the effects of the hail and by the latter part of July had set a fairly good crop of bolls. On July 31st torrential rains commenced and continued for eleven days in succession, making an impassable swamp of the cotton fields, causing grown bolls to decay without opening and causing immature bolls to be shed by thousands. Lastly, this experiment was overtaken by the tropical hurricane of September 20th, before picking was completed, and much of the remaining cotton blown from the bolls or buried in the ground. The results of the experiments at Lakeland are indicative of what might have been expected had these natural calamities not have occurred, but despite the small production they are strongly corroborative of the conclusions drawn from experiments elsewhere. The experiments made at Shaw, Woodside and Mansfield were not subjected to extreme climatic conditions and their outcome was far more satisfactory.

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*This Circular will be sent, free, on request to the Crop Pest Commission, Baton Rouge, La.

EXPERIMENTS IN 1908.

FIELD EXPERIMENT AT MANSFIELD, DE SOTO PARISH.

This experiment was planned and carried out by Mr. A. R. Roach, on his farm about four miles from Mansfield. The experiment was visited but twice during the season by representatives of the Commission. Mr. Roach applied the poison himself and kept all records of the production, which he kindly supplied for our information.

The field selected by Mr. Roach for this experiment was sandy upland that had been in cotton the year previous. The field was planted to the Mebane Triumph variety in the spring of 1908, 300 pounds of acid phosphate per acre being applied as fertilizer before planting. The rows were four feet apart and the plants averaged 18 inches apart in the drill.

On May 28th Mr. Roach made a single application of the powdered arsenate to approximately one-half of this field, the application being made with the "Champion" dust sprayer and pains taken to force the powder well into the buds and terminal leaves.[*] One pound per acre was used.[†]

On July 6, 1908, the experiment was visited by Mr. G. A. Runner, Assistant Entomologist of the Commission, who made a careful count of infested squares in both the poisoned and non-poisoned plats. In the poisoned plat he found an average of 8.4 per cent of the squares infested and in the non-poisoned plat 10 per cent of the squares infested. In the poisoned plat 7 per cent of the bolls were infested and in the check plat 6 per cent. A count was also made of the number of bolls on one hundred average-sized plants in each plat. The average number of bolls to the plant in the poisoned plat was 7.4 and in the check plat 7.3. These examinations did not indicate any pronounced advantage in the poisoned plat, but on October 10, 1908, Mr. Roach wrote us as follows:

"Having finished gathering all the cotton connected with my experimental work this year, I herewith attach a statement of the number of pounds of seed cotton picked. * * *

"Poisoned plat..............................5,068 lbs. seed cotton.
"Non-poisoned plat ....4,682 lbs. seed cotton."

The areas of these plats had been accurately determined the year previous and had been found as follows:

Poisoned plat	4.83 acres
Non-poisoned plat	4.712 acres

The following table shows the production per acre in the two plats:

PLAT	Yield, Pounds Seed Cotton	Acreage	Yield per Acre, lbs Seed Cotton
Poisoned	5068	4.83	1049
Check (not poisoned)	4682	4.712	993
Increased yield in poisoned field, per acre			56 lbs.

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[*] See Circular 23, pp. 32-37; also, page 266 of the present Circular.

[†] An amount too small for best results, as was learned in later experiments.

Calculating the value of this increased production of 56 pounds seed cotton per acre at 10 cents per pound for lint and $18.00 per ton for seed we have:

21 lbs. lint*, at 10 cents	$2.10
35 lbs. seed at $18.00 per ton	.32
Total value	$2.42

The profit derived from this extra production can be determined only by deducting the cost of poison used and the cost of labor for applying it. This cost per acre was as follows:

1 pound powdered arsenate of lead at 22 cents	$ .22
Labor, one application, one-fifth day at $1 per day	.20
Total cost, per acre	$ .42

Deducting this cost ($0.42 per acre) from the value of the increased production ($2.42 per acre) we see that the net profit to Mr. Roach from the one application was $2.00 per acre.†

EXPERIMENTS WITH A LIQUID SPRAY OF LEAD ARSENATE.

As the paste form of lead arsenate is of practically the same chemical composition as the powdered arsenate of lead, experiments were planned in the spring of 1908 wherein the liquid spray was to be used.

One of these experiments was located on the farm of Mr. Xavier Nick, near Marksville, and included two varieties, Simpkins and Mortgage Lifter. A part of each variety was sprayed with Fred L. Lavanberg's paste arsenate of lead on May 23, 1908, the mixture being made at the rate of 2 pounds of the arsenate to 50 gallons of water and the plants thoroughly soaked with the solution. Records of production were kept by Mr. Nick and the areas of the several plats were determined by Mr. W. R.

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*Based on a gin yield of 37 per cent lint from seed cotton. The Triumph ordinarily gins from 37 to 39 per cent.

†An interesting feature of this experiment lay in the fact that it was made on the same plats that were devoted to an experiment with Paris green the preceding year. The plat receiving poison was the same in both years; the cotton was even planted on the same rows in both seasons. In 1907 the plat poisoned with Paris green produced 803 pounds of seed cotton per acre and the non-poisoned 900 pounds per acre. The application of Paris green in 1907 caused a *decrease* in production of 97 pounds per acre, while the application of powdered arsenate of lead to the same plat in 1908 caused an *increase* of 56 pounds per acre.

Messick, a civil engineer of Marksville. The productions of the poisoned and non-poisoned portions of each variety are given below:

VARIETY.	YIELD PER ACRE, LBS. SEED COTTON.		EFFECT OF POISONING.	
	Poisoned.	Non-poisoned.	Gain, Per Acre. (Pounds.)	Loss, Per Acre. (Pounds.)
Mortgage Lifter	691	713		22
Simpkins	925.4	838.1	87.3	
Average, both varieties	798	772	26	

It is thus seen that in one variety the poisoned plat produced less than the check. This plat was located nearer to timber than the check plat of the same variety and this may have accounted for the more severe damage to this plat. It is evident that the heavy application of the liquid spray did not offset the heavier weevil damage due to the field being located nearer to the timber. The average gain in both varieties, due to spraying, was so small that the work and expense of spraying were not justified.

A similar experiment with the liquid lead arsenate spray was made on the farm of Mr. Frank Laborde, of Marksville. In this case the cotton was also of the Simpkins variety and the field in which the experiment was made was surrounded by timber. Weevil infestation was excessively heavy throughout the season. A part of this field was sprayed on May 11th, the strength of the mixture being the same as in the Nick experiment, 2 pounds of the paste arsenate to 50 gallons of water. The production of the two parts of the field was as follows:

Poisoned	523 lbs. seed cotton per acre
Non-poisoned	564 lbs. seed cotton per acre

As the season advanced it was seen that the cotton in the poisoned plat, owing to some difference in soil or drainage, was more rank and luxuriant than that in the check plat, making conditions for the boll weevil most favorable in the former. It is significant that the spraying did not even offset the extra weevil injury due to rank growth of the plants.

The reader will at once see that these experiments with the liquid spray of lead arsenate were, to all practical purposes, failures. They were carefully made, adequate checks were provided and their results may be taken as reliably indicating that the use of lead arsenate as a liquid spray has few if any chances of resulting profitably. Even if a considerable increase in cotton production followed the use of liquid sprays, the cost and labor involved in spraying a cotton field would make the operation unprofitable.

The explanation of the difference in results obtained from the liquid lead arsenate spray and the powdered arsenate of lead lies in the fact that the powdered form of the poison can be more thoroughly forced into the terminal buds and involucres and in the fact that much more of the powdered form can be made to adhere to the plants than when it is applied in liquid form.

We recite the outcome of these experiments with the liquid sprays merely to place the farmers on their guard against such preparations, and particularly against the folly of trying to use liquid sprays of any kind in a cotton field.

CAGE EXPERIMENTS WITH POWDERED ARSENATE OF LEAD, ON COTTON IN FULL FRUITAGE.

The high mortality among the boll weevils which followed the application of powdered arsenate of lead to the cotton plants just before the first squares appeared* naturally suggested experiments to determine whether any considerable number of the weevils could be killed with it when squares and bolls were present on the plants. Such experiments were arranged for, during the summer of 1908, on the plantation of Mr. W. C. Harris, near Alexandria. These experiments were made by Mr. G. A. Runner, then Assistant Entomologist of the Commission.

During July and August insect-tight cages were constructed over growing cotton plants of the Triumph variety. Each cage was 5x5 feet, 6½ feet high and covered a single plant. At this time the plants were about 5 feet in height and bore an average of 15 bolls each, together with a large number of squares. Of the latter, approximately 40 per cent were weevil-infested. Before the experiment was started all fallen, hanging and dried infested squares were removed from the plants in the cages so that the mortality due to the poison would not be complicated by the emergence of young weevils from squares after the poisoning.

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*See Circular No. 23, page 26.

To facilitate the finding of dead weevils the ground in each cage was carefully smoothed and packed with a trowel.

Each experiment consisted of two cages, one containing a cotton plant poisoned with the arsenate and the other a similar cotton plant that was not poisoned, the object being to compare the natural mortality of the weevils with the mortality caused by the poison.

The first experiment was started by Mr. Runner on July 30, 1908, by liberally poisoning a caged cotton plant with Grasselli's powdered arsenate of lead. Immediately after the poison was applied 100 adult boll weevils were liberated in the cage and the latter tightly closed. At the same time 100 adult boll weevils were liberated in the cage which contained the non-poisoned cotton plant.

A heavy rain fell about two hours after the poison was applied in this experiment and rains were of daily occurrence for the week following.

The first examination of the cages was made on August 1st, two days after the application of the poison. In the cage containing the poisoned plant Mr. Runner found 41 weevils dead, 11 missing and 48 alive. In the cage containing the non-poisoned plant he found 8 weevils dead, 16 missing and 76 alive. The live weevils were not removed from the cages, but were left in them for further observations.

The second examination of the cages was made on August 3rd, four days after the application of poison. On this date Mr. Runner found, in the "poisoned cage," 69 weevils dead, 21 missing and 10 alive. In the non-poisoned, or "check," cage he found 24 dead, 18 missing and 58 alive.

The third examination was made on August 5th, six days after the poison was applied, with the result that in the poisoned cage 71 weevils were found dead, 26 missing and 3 alive. In the check cage 28 were dead, 25 missing and 47 alive. The three weevils still alive on the poisoned plant were found feeding on new squares which appeared after the application of the poison on July 30th.

The last examination, made 8 days after the poisoning, showed all weevils dead in the cage containing the poisoned plant. In the check cage 39 weevils were still alive. The results of these examinations are summarized in the following table:

TABLE I.

MORTALITY CAUSED BY POWDERED ARSENATE OF LEAD WHEN APPLIED TO COTTON PLANTS IN FULL FRUITAGE.

EXPERIMENT No. 1.

Experiment started July 30, 1908, by confining 100 adult boll weevils in Cage 1, to the cotton in which powdered arsenate of lead had been applied; and 100 in Cage 2, to the cotton in which no poison had been applied.

	CAGE NO. 1—POISONED							CAGE NO. 2—NOT POISONED								
						KILLED BY POISON AND NATURAL CAUSES COMBINED.							KILLED BY NATURAL CAUSES ALONE.		MORTALITY DUE TO THE POISON ALONE.	
DATE OF EXAMINATION	Original Number of Weevils.	Number Found Alive.	Number Dead.	Number Missing.	Dead and Missing Combined.	Number.	Per Cent.	Original Number of Weevils.	Number Alive.	Number Dead.	Number Missing.	Dead and Missing Combined.	Number.	Per Cent.	During	Per Cent Killed.
August 1	100	48	41	11	52	52	52	100	76	8	16	24	24	24	2 days	28
August 3	100	10	69	21	90	90	90	100	58	24	18	42	42	42	4 days	48
August 5	100	3	71	26	97	97	97	100	47	28	25	53	53	53	6 days	44*
August 7	100	0	73	27	100	100	100	100	39	32	29	61	61	61	8 days	39*

*For an explanation of this apparently decreasing mortality at successive examinations see Circular No. 23, page 24, foot note.

In all, four experiments of this kind were made by Mr. Runner, each experiment being started with fresh plants and with adult boll weevils freshly collected from the surrounding cotton fields. The results of these experiments are given in the following table:

TABLE II.

Percentage of Boll Weevils Killed by Application of Powdered Arsenate of Lead to Cotton in Full Fruitage, Four Experiments.

Experiment No.	Date Begun.	Date Finished.*	WEEVILS KILLED BY THE POWDERED ARSENATE OF LEAD.		Natural Mortality During the Same Period (that is, the death rate of weevils on cotton that was *not* poisoned).
			During	Per Cent.	
1	July 30	August 3	4 days	48	42
2	August 1	August 7	6 days	57	38
3	August 7	August 11	4 days	39	54
4	August 11	August 15	4 days	48	43

The number of weevils killed in these experiments was surprising, particularly as it had always been supposed that comparatively few of the weevils could be killed with poison after the squares appeared. During the course of the experiments Mr. Runner carefully observed the actions of the weevils confined on both the poisoned and non-poisoned cotton plants. While many of the weevils fed, as usual, by inserting their beaks into the squares and eating the pollen, a larger number than anticipated fed upon the green bolls, in the terminal buds, in the blossoms and on the edges of the involucre (shuck) surrounding the tender squares. All of these are situations which can readily be reached with the powdered arsenate of lead when it is applied with a powerful blast of air.

While the percentage of weevils killed by the arsenate, on fruiting cotton, was considerably smaller than the percentage killed on small cotton in the budding stage, the outcome of these experiments at least indicated that something might be accomplished by continuing the applications of powdered arsenate for a time after the first squares appear on the plants in spring. The field experiments for 1909 were planned accordingly.

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*By "date finished" is meant the date upon which the true mortality, due to the poison, was determined, as explained in the footnote on page 24 of Circular No. 23.

THE FIELD EXPERIMENTS OF 1909.

With the foregoing information before us, but still in ignorance of the amount of powdered arsenate to apply to best advantage and of how many applications to make, we arranged the 1909 experiments so that varying amounts of the poison were tested. All of the field experiments were located in localities where conditions were thought to be most favorable to the weevils, so as to afford the severest possible test of the poison. The various experiments are described separately below.

METHOD OF MAKING FIELD EXPERIMENTS.

The real effect of the application of any poison, in increasing or reducing the yield of cotton, can be determined only by comparing the actual production of cotton which is poisoned with that of cotton which is not poisoned, the two fields or plats being of the same variety and in all other respects under the same conditions. The cotton from both plats must be accurately weighed when it is picked and the areas must be determined by a competent surveyor, so that the *exact* production per acre will be known in the case of both the poisoned and non-poisoned cotton. So many conditions may affect the yield that no other method of experimentation can prove reliable. Drainage, condition of soil, preceding crops, the length of time the land has been in cultivation and numerous other factors may operate to affect the comparative yield in adjoining fields or even in different parts of the same field. It is therefore of the utmost importance that both the poisoned and non-poisoned plats be on soil uniform in character and equally well drained throughout. The cotton must be of one variety only and both plats must be planted upon the same date. They should even be cared for by the same tenant or laborer. To attain these conditions we have usually followed the plan of selecting a field for the experiment after the cotton is well up and chopped out. The most uniform field in a neighborhood is selected and arrangements made with the owner for the experimental work. The field is then divided into two parts, to one of which the poison is applied. In other cases we have selected the land in advance of planting and made arrangements with the owner to prepare the soil, plant the entire area upon a given date and to give it all the same cultivation throughout the season.

SQUARE INFESTATION.

In the course of repeated experiments, made with various objects in view, it has been found that the percentage of squares infested in the early part of the season offers a more or less reliable indication of the extent to which the crop is being cut short by the boll weevil. For example, if only a small per cent of the squares is infested until August 1st, a fair crop may be expected; on the other hand, a heavy infestation of the squares during June and July is always followed by a much reduced yield. Destruction of any considerable number of weevils in a cotton field means, of course, fewer squares punctured and destroyed. The application of a suitable poison should therefore be followed by a reduction of the square infestation, as compared to infestation in similar plats not poisoned. Or, when the weevils are increasing at a rapid rate, the application of a poison should retard the rate of increase in square infestation.

Thus it follows that the effect of applying a poison can be to a certain extent determined by examining a large number of squares in both poisoned and non-poisoned plats and comparing the two. Observations of this kind were made from time to time in all of our experiments with the powdered arsenate of lead and will be found recorded in the paragraphs describing the different experiments.

HOW PROFIT OR LOSS FROM POISONING IS DETERMINED.

It is not sufficient that the portion of a field to which poison is applied should merely yield more cotton to the acre than the non-poisoned portion. The cost of the poison used, as well as cost of the labor for applying it, must be known and deducted from the value of the increased yield. Let us suppose, for example, that a poison is applied to half of a field and it is found at the end of the season that the poisoned cotton has yielded 30 pounds (per acre) of seed cotton more than the non-poisoned portion, and that the cost of the poison and of applying it has been $2.00 per acre. If lint sells at 13 cents and seed at $16.00, the market value of the increase in production is:

10 pounds lint at 13 cents	$1.30
20 pounds seed at $16.00 per ton	.16
Total value of increase	$1.46

It has therefore cost the farmer $2.00 to make cotton and seed worth $1.46, or, in other words, the poisoning operation has resulted in a net loss of 54 cents an acre.* If, on the other hand, the poisoning is followed by an increase in lint and seed worth $5.00 per acre, and the cost of poison and labor is the same as in the preceding example (that is, $2.00 per acre) then a profit of $3.00 per acre follows the operation.

The price which is paid for poison, the cost of labor and the market price received for lint and seed, all go to determine the amount of profit or loss following the use of a poison for the boll weevil. This is referred to more in detail on subsequent pages.

THE POISON USED.

It shuld be distinctly understood that the poison used in all of the experiments described upon succeeding pages was powdered arsenate of lead. This poison was developed in the course of our boll weevil investigations during 1906-07 and was first described in Circular No. 23 of the Commission. The particular arsenate used in our experiments during 1909 was "Grasselli's powdered arsenate of lead," manufactured by the Grasselli Chemical Co., of Cleveland, Ohio, and New Orleans, La.†

METHOD OF APPLYING THE POISON.

The cage experiments in the spring of 1908 showed that a heavier mortality occurred among the weevils when the powdered arsenate of lead was applied with a strong current of air, than when it was applied by dusting from a sack. The reason for this difference in results is not hard to find. The weevil's principal feeding places are the squares and in the leaves comprising the tender "bud" at the top of the central stem or shoot, and at the end of each fruit limb. When poison is dusted over the plants from a sack, as is usually done in applying Paris green to cotton, the poison merely settles on the *outside* of the buds and on the "shucks" surrounding the squares. It does not penetrate between the small leaves of the terminal bud; nor does it get onto the exterior surface of the square (not shuck) itself. where the weevils can secure it when feeding. It is therefore next to useless to try to destroy the weevils by using the dust-

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*In a few of the many experiments we have made with Paris green as a boll weevil poison, during the past five seasons, the poisoned plats have shown a slight increase in production over the non-poisoned, but it is significant that in all such cases the increase in yield has not been sufficient to pay for the Paris green and the labor involved in its application. The majority of experiments with Paris green have shown an actual decrease in yield following its use, due to the poisonous effect of the "green" on the cotton plants themselves.

†We are under obligations to the Grasselli Chemical Co. for their kindness in donating the 1,700 pounds of powdered arsenate of lead which was used in these experiments.

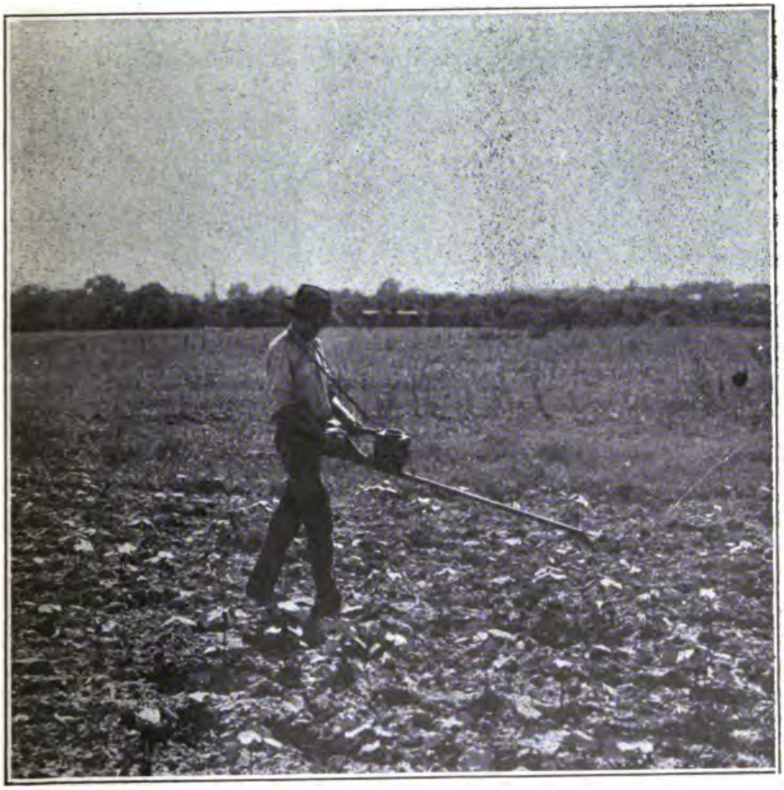

FIG. 2.—Applying powdered arsenate of lead to cotton plants in the "budding stage" by means of a "Champion" dust gun. The secret of success lies in *forcing* the powder *into* the terminal buds with a strong current of air. (Original.)

ing method of application. This is fully borne out by field experience. In our own experiments, wherever the application has been made by dusting the arsenate onto the cotton plants, failure has been the result. All those planters who have tried the arsenate the past season and who have applied it by the "bag method"—which most of them did, against our advice—have reported it a failure.

In practically every instance where the powdered arsenate has been applied with a Champion dust gun, in the right manner, the right amount and at the right time, the outcome has been profitable. In all of the experiments described below the "Champion" dust gun, manufactured by Leggett & Bro., of New York,* has been used in making the applications of arsenate. This machine is small and light enough to be carried and operated by one man (see Figure 2). One hand turns the handle which operates the fan, while the other hand is used to direct the nozzle against the buds and squares. With one of these machines an active, intelligent negro laborer will apply the poison to about six acres during a working day of 10 hours. We do not mean to say that the mere use of the Champion dust gun, or of a similar device, will insure success. It is a very easy matter indeed to use this machine in such a manner that practically all of the poison will be wasted. *The key to success lies in getting the poison into every terminal bud, into every blossom, and into the involucre of every square, and getting it there with force.* Doing this work properly is no more difficult than many other farming operations, but the average plantation negro can no more be depended upon to do it right, without immediate supervision by an intelligent white man, than he can be to weigh his own cotton during picking time.

The principles which underlie successful poisoning of the weevil must be thoroughly understood by the planter who undertakes to use the powdered arsenate of lead, and these principles must be perfectly applied in practice.

Any mechanical device which would force the poison deeply into the terminal buds would, of course, answer as well for this work as does the Champion dust gun, but unfortunately, no other device of the kind seems to be on the market.

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*To the Doherty Hardware Co., of Baton Rouge, we are indebted for liberal discounts on the Champion dust guns which we purchased of them for use in these experiments.

We have tested a "mechanical cotton duster," also made by Leggett & Bro., which is drawn by horses and which is built on much the same principle as the small Champion duster. It is intended to apply the poison to several rows at once but we found it totally unadapted to the work in hand. The machine was mechanically imperfect in many respects, but its weakest feature lay in the fact that the nozzles could not be directed to every plant and bud as is done when the Champion duster is employed. In justice to the manufacturers of the mechanical duster it should be said that the machine is capable of much improvement and a practical device of this kind may yet be perfected. The problem presented, however, is much like that confronting the manufacturer of cotton picking machinery. Mechanical appliances cannot entirely do the work of nimble hands and fingers directed by human intelligence.

EXPERIMENTS AT LAKELAND, POINTE COUPEE PARISH.

The experimental work at Lakeland consisted of several separate and distinct experiments with the powdered arsenate of lead, with which was combined an experimental test of different early maturing varieties of cotton.

All of these experiments were located on Oakland Plantation, owned and operated by the Phillips Bros. Planting Co. The experimental fields were located about two miles from False River* and about six miles from the Mississippi River. The soil is fairly typical of the alluvial lands of the Mississippi bottom.

The planting, cultivation and gathering of the crop were all done by Messrs. Phillips Bros., to whom we are indebted for the records of production, as well as for much valuable assistance and many courtesies rendered during the season. The applications of the powdered arsenate of lead were made by colored plantation hands, under the immediate personal supervision of the junior author. Measurements of all plats were officially made by Mr. S. N. Garrett, a civil engineer of New Roads, La.

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*False River is an old channel of the Mississippi River, now a lake several miles in length.

The particular fields selected for the experimental work were well drained by means of deep, open ditches which emptied into a bayou adjoining the fields.

Preparation and Cultivation.

During the early part of December, 1908, all cotton plants on these fields were destroyed and the land plowed. The brush along the adjoining bayous was cut down and grass, weeds, etc., along the ditch banks were burned. Though the cotton plants were not destroyed as early as desirable, the "cleaning up" of the fields and surroundings was as perfect as labor and care could make it.

Between March 15 and 25, 1909, the land was prepared for planting. The dirt was first thrown from the middles onto the old beds with a Moline plow, after which it was thoroughly pulverized and all lumps broken up. Between March 27th and April 5th the beds were gone over twice with a small-toothed harrow.

All plats were planted on April 5th and 6th, under ideal conditions. The cotton came up well but on April 30th a severe hail storm occurred which almost destroyed the young plants, and it seemed very doubtful whether a stand could be secured. However, the cotton was chopped out and excellent care given it by Phillips Bros., with the result that it recovered sufficiently from the effects of the hail to present a partially satisfactory stand.

Frequent shallow cultivations were given the cotton until about the middle of July, except when wet weather prevented.

The experiments were so arranged that the production of cotton poisoned with the powdered arsenate of lead could be compared with the production of non-poisoned cotton of the same variety, planted on the same soil at the same time and cared for in identically the same manner throughout the season.

The experiments at Lakeland differ from each other principally in the number of applications made to the poisoned plats and in the fact that the varieties of cotton were not the same in all experiments.

In the experiments designated below as A, B, C, D and E, the poisoned plat of each experiment was separated from the non-poisoned plat by only a plantation roadway. In experiments F and G the two plats of each experiment were separated by intervals of growing cotton. Experiment H consisted of a field, one-half of which received the arsenate and the other half did not. Messrs. Phillips Bros. also experimented, independently, with the powdered arsenate of lead, so that, in all, 121 acres were included in the experiments at Lakeland. Of this area, 68 acres received powdered arsenate of lead and 53 acres were included in the various check areas.

By the latter part of July the cotton was well fruited and there was every indication that upwards of a half bale per acre would be made, despite the injury done by the hail storm. On July 31st heavy rains began and continued for eleven days. The experimental fields became a swamp; the large bolls decayed, while small bolls and forms were shed by the thousands. On September 20th the tropical hurricane prostrated the plants and blew much of the open cotton from the bolls. In short, the storms which beset these fields cut short the production far more than the boll weevil did, but in spite of them all we secured an increased actual production in the majority of the poisoned plats.

The first application of the powdered arsenate of lead was made on June 9th, the majority of the cotton plants being then in the "budding stage" (see Figure 4). Just prior to this application the weevils were counted upon rows in various parts of the experimental areas and it was found that there was an average of 35 boll weevils per acre.* Between applications of the poison similar examinations were made in both poisoned and checks plats to determine the effect of poison on the number of weevils present. As soon as a sufficient number of squares appeared, this method of observation was superseded by examinations of the squares themselves to determine what per cent was infested.

EXPERIMENT A.

Two Applications. Variety, Cook's Improved.

On June 9th the cotton was beginning to square and the first application of powdered arsenate of lead was made, the Champion dust gun being used and pains taken to force the poison thoroughly into all terminal buds.

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*On the same date examinations were made of cotton fields on adjoining plantations where no attempt had been made the previous autumn to destroy the cotton plants. On one of these places an average of 392 weevils per acre was found on June 9th, and on the other an average of 479 per acre. Thus was the practical value of fall destruction shown, even though the work on Oakland was not done early enough to insure the maximum amount of good.

The poison was applied at the rate of 1 pound per acre. In this, as in all other experiments, the amount of poison used was carefully weighed out and the time required for the application carefully noted and recorded. This made it easy to ascertain the exact cost of the poison and labor required for each application. Negro hands were employed at the rate of 80 cents per day of ten hours. The cost of the powdered arsenate has been figured at its actual market price at the time the experiments were made, 22 cents per pound.

The poisoned plat contained 4.1 acres and the application was made by one negro hand in 4 hours. The cost of this application was therefore:

Labor, 4 hours at $0.08	$0.32
Arsenate, 4.1 lbs., at $0.22	.90
Total	$1.22

or, $0.30 per acre.

On June 16th, one week after the first application of arsenate, both the poisoned and non-poisoned plats were examined and the weevils present were counted on rows in different parts of each plat. It was found that the plat which had received the poison now contained an average of 22 weevils per acre and the check (non-poisoned) plat an average of 44 weevils per acre; a reduction of 13 weevils per acre where the poison had been applied and an increase of 9 per acre where it had not been applied.* By this date squares were quite numerous on the plants and the percentage of squares punctured by the weevils was determined by examining a large number of squares in each plat. In the plat which had been poisoned an average of 5.2 per cent of the squares was found infested; in the non-poisoned plat, an average of 22 per cent was infested.

On June 16th also, the second application of the powdered arsenate was made. 1.2 pounds per acre were applied with the

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*The plat receiving the poison was located at one edge of the plantation, and immediately adjoined a plantation upon which cotton plants were not destroyed the previous autumn. The check plat was nearer to the center of Oakland Plantation, over all of which the cotton plants were destroyed in December. The plat receiving poison was therefore more exposed to the influx of weevils coming from hibernating quarters than was the check plat. The same applies also to Experiments B, C, D and E.

Champion dust gun, the work being carefully done, as before The cost of this application was as follows:

Labor, 4 hours, one man, at $0.08 per hour	$0.32
Powdered arsenate, 4.9 lbs., at 22 cents	1.08
Total cost for plat	$1.40

or, $0.34 per acre.

The two applications therefore cost, for both labor and poison, $2.62 for the plat of 4.1 acres, or $0.64 per acre.

Though no more poison was applied in this experiment, the two plats were examined from time to time during the season and the percentage of infested squares noted. The following table shows the relative square infestation in the two plats during the growing season:

Powdered arsenate applied June 9 and June 16.

DATE OF EXAMINATION.	Per Cent of Squares Infested in Poisoned Plat.	Per Cent of Squares Infested in Non-poisoned or Check Plat.
June 16	5.2	22
June 23	11.2	19.6
June 30	5.6	17.6
July 8	17.6	9.2
July 12	20.8	18.4
July 21	30.4	36
July 28	48	66
August 4	77.6	86.6
August 10	90.6	93.6

Production.

The plat which received the poison yielded 1,010 pounds of seed cotton, or 246.34 pounds per acre.

The check plat, containing 4.26 acres, yielded a total of 350 pounds seed cotton, or 82.1 pounds per acre.

The poisoned cotton, therefore, yielded 164.24 pounds more per acre than the non-poisoned.

If we value this increased production on the basis of 13 cents per pound for lint and $16.00 per ton for seed,* we find it to be worth:

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*These prices are adopted because the bulk of the cotton and seed produced in our 1909 experiments was sold at approximately these, or better, prices. To what a marked extent the price of cotton affects the profit derived from using the arsenate is explained in the footnote on page 292.

54.7 lbs. lint at 13 cents	$7.11
109 lbs. seed at $16.00 per ton	.87
Total value of increased production, per acre	$7.98

The cost of the poisoning was $0.64 per acre. This should be deducted from the value of the increased production, which leaves us $7.34 as the *net profit* per acre from the two applications of the powdered arsenate in this experiment.

As all of the experiments at Lakeland were carried out along the same general lines as the foregoing, we have condensed the data so as to describe the remaining experiments as briefly as possible.

EXPERIMENT B.

Three Applications. Variety, Cleveland Big Boll.

The poisoned plat in this experiment adjoined the poisoned plat of Experiment A and was separated from it by three rows of corn, planted early in the season, to prevent confusion as to the boundaries of the plats. The check plat of B was separated in the same manner from the check plat of Experiment A.

The poisoned plat in this experiment (B) received its first two applications of powdered arsenate at the same time and at the same rate as did the poisoned plat in Experiment A; that is, 1 pound per acre on June 9th and 1.2 pounds per acre on June 16th.

The third application was made on June 24th, at the rate of 2.46 pounds per acre.*

Following is a brief statement of the amount of poison used at each application, its cost and the amount and cost of labor required for applying it:

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*It is, of course, impossible to apply *exactly* the amount of arsenate desired. We therefore give the amount that was actually used, as determined by weighing the poison in advance and afterwards dividing the total amount used by the number of acres in the field or plat.

APPLICATION.	DATE.	Pounds Arsenate Applied Per Acre.	Labor Required, Time of One Man, Hours Per Acre.	Cost of Arsenate Per Acre at $.22 Per Pound.	Cost of Labor at $.08 Per Hour.
1st	June 9	1	⅞ hour	$ .22	$ .07
2nd	June 16	1.2	1 "	.26	.08
3rd	June 24	2.46	2 "	.54	.16
	Totals	4.66	3⅞ hrs.	$1.02	$ .31

Total cost per acre, for both labor and poison $1.33

Square Infestation in Poisoned and Check Plats.

As in the preceding experiment, examination of both plats was made a week after each application of arsenate, as well as at intervals for several weeks after the third application was made. The results of these examinations are given below:

Powdered arsenate applied June 9, June 16 and June 24.

DATE OF EXAMINATION	Per Cent of Squares Infested in Poisoned Plat.	Per Cent of Squares Infested in Non-poisoned Plat.
June 16	5.2	22
June 23	6	22.4
June 30	10.4	10 8
July 8	12.4	12.4
July 12	17.6	29.2
July 21	26.8	48
July 28	55.6	62.8
August 4	73.6	74.8
August 10	92	90.4

Production.

The yield of the poisoned plat, as shown by the record of weights kept by Phillips Bros., and the areas as determined by Mr. S. N. Garrett, was 485.7 pounds seed cotton per acre. The yield of the check plat, determined in the same manner, was 180.3 pounds seed cotton per acre. The excess in yield where the poison was used was, therefore, 305.4 pounds per acre.

Computing the value of this increased yield, we have:

102 lbs. lint at $0.13	$13.26
203 lbs. seed, at $16.00 per ton	1.62
Total value of increase	$14.88

Deducting from this the cost ($1.33) of poison and labor of applying it, we find that a *net profit* of $13.55 per acre followed the three applications.

EXPERIMENT C.

Four Applications. Variety, Peebles' Chosen.

This experiment was located beside Experiment B and was separated from the latter by three rows of corn. Only a plantation roadway separated the poisoned and check plats.

The poisoned plat in this experiment received its first, second and third applications at the same time and at the same rate as did the poisoned plat in Experiment B. The fourth application was made on June 30th at the rate of 2.4 pounds per acre. Following are the applications given this plat and the cost of each:

APPLICATION.	DATE.	Pounds Arsenate Per Acre.	Labor Required, Time of One Man, Hours Per Acre.	Cost of Arsenate Per Acre at $.22 Per Pound.	Cost of Labor at $.08 Per Hour.
1st	June 9	1	1	$ .22	$ .08
2nd	June 16	1.2	1	.26	.08
3rd	June 24	2.46	2	.54	.16
4th	June 30	2.42	1⅞	.53	.15
	Totals	7.08	5⅞	$1.55	$ .47

Total cost per acre, for both labor and poison $2.02

Square Infestation.

Weekly examinations to determine percentage of squares infested in both the poisoned and check plats were made, as in the two preceding experiments. These examinations resulted as shown below:

DATE OF EXAMINATION.	Per Cent of Squares Infested, Poisoned Plat.	Per Cent of Squares Infested, Non-poisoned Plat.
June 16	5	22
June 23	6	22
June 30	5.2	13.6
July 8	4.8	12.8
July 12	14	25.2
July 21	34.4	46
July 28	38	56.8
August 4	78.8	86.8
August 10	90.8	90.8

Production.

The yield of the poisoned plat was 208.7 pounds seed cotton per acre;* that of the non-poisoned, 161.6 pounds per acre. The excess in yield of the poisoned plat was therefore 47.1 pounds seed cotton per acre. Calculating the value of this 47 pounds we have:

15.7 lbs. lint at $0.13	$2.04
31 lbs. seed at $16.00 per ton	.25
Total value of increase in production	$2.29

Deducting from this $2.29 the cost of poisoning ($2.02 per acre), we find that a profit of only $0.27 per acre was secured in this experiment.

The much smaller increase in production, following the use of poison, in this experiment, as compared to the preceding and succeeding ones, is not easy to account for. All conditions in this plat, except for the variety of cotton, and the number of applications of poison, were identical with those in the other experiments.

EXPERIMENT D.

Five Applications. Variety, Rublee's Anti-Boll Weevil Cotton.

This experiment was bounded on one side by Experiment C and the other by Experiment E, the roadway separating poisoned and check plats. The first, second, third and fourth applications were made to the poisoned plat of this experiment at the same time, and at the same rate, as to the poisoned plat in Experiment C. The fifth application was given on July 8th, at the rate of 3.51 pounds per acre. The time and rate of each application can be readily seen by consulting the following table:

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*It should not be inferred that we consider 208 pounds of seed cotton a profitable crop. It is not within our province to decide what production is a profitable crop for the farmer, and, as pointed out on a preceding page, we are not trying to show that the use of powdered arsenate of lead will *insure* a successful crop. By "profit" we mean the profit derived *from using powdered arsenate of lead.* The question we are seeking an answer for is not: "Will the powdered arsenate make a profit-returning crop?" but rather: "Will it pay the farmer to use the powdered arsenate *if he grows cotton?*"

APPLICATION	DATE.	Pounds Arsenate Per Acre.	Labor Required, One Man, Hours Per Acre.	Cost of Arsenate Per Acre, at $.22 Per Pound.	Cost of Labor Per Acre, at $.08 Per Hour.
1st	June 9	1	1	$ .22	$ .08
2nd	June 16	1.2	1	.26	.08
3rd	June 24	2.46	2	.54	.16
4th	June 30	2.42	1⅞	.53	.15
5th	July 8	3.51	2⅛	.77	.17
	Totals	10.59	8	$2.32	$ .64

Total cost per acre, for both labor and poison $2.96

Square Infestation.

The average percentage of squares infested in poisoned and check plats at weekly intervals following the poisoning is given below:

DATE OF EXAMINATION	AVERAGE PER CENT OF SQUARES INFESTED	
	Poisoned plat	Non-poisoned plat
June 30	5	14
July 8	7.2	15.2
July 12	15.2	22.4
July 21	44	53.6
July 28	56	61.6
August 4	74.8	79.6
August 10	90	90

Production.

The yield of the poisoned plat was 672.7 pounds seed cotton per acre; that of the check plat, 127.9 pounds per acre. The five applications of poison to the poisoned plat, therefore, resulted in an increase of 544.8 pounds seed cotton per acre. Valuing this as in the preceding experiments, we have:

182 lbs. lint at $0.13	$23.66
363 lbs. seed at $16.00 per ton	2.90
Total value of increased production	$26.50

Deducting from this the cost of poison and labor ($2.96) per acre, we see that the net profit from poisoning with the arsenate was $23.54 per acre.

EXPERIMENT E.

Six Applications. Variety, Simpkins.

This experiment was bounded on one side by the cotton in Experiment D, and on the other side, its poisoned plat was adjoined by the corresponding plat of Experiment F, while the check plat was adjoined by a field of corn.

The first five applications of powdered arsenate of lead were made at the same time and at the same rate as the first five applications to the poisoned plat in Experiment D. The sixth application was made on July 12th at the rate of 3.95 pounds per acre.

The salient facts relative to the six applications to the poisoned plat are given below:

APPLICATION	DATE.	Pounds Arsenate Per Acre.	Labor Required. (Hours.)	Cost of Arsenate Per Acre, at $.22 Per Pound.	Cost of Labor Per Acre, at $.08 Per Hour.
1st	June 9	1	1	$ .22	$.08
2nd	June 16	1.2	1	.26	.08
3rd	June 24	2.46	2	.54	.16
4th	June 30	2.42	1⅞	.53	.15
5th	July 8	3.51	2⅛	.77	.17
6th	July 12	3.95	2	.87	.16
	Totals	14.54	10.00	$3.19	$ .80

Total cost per acre, for both labor and arsenate, six applications $3.99

Square Infestation.

The relative square infestation by weekly intervals, in the poisoned and check plats, is given below:

DATE OF EXAMINATION	AVERAGE PER CENT OF SQUARES INFESTED	
	Poisoned plat	Non-poisoned plat
July 8	7	15
July 12	8.8	23.6
July 21	33.2	53.6
July 28	49.2	67.2
August 4	70	83.2
August 10	90	94.8

Production.

The plat which received the six applications of powdered arsenate produced at the rate of 342.9 pounds seed cotton per acre; the non-poisoned, at the rate of 103.1 pounds per acre. The poisoned cotton, therefore, yielded 239.8 pounds (seed cotton) more per acre than the non-poisoned. Placing on this increased yield the same valuation as in the preceding experiments, we have:

80 lbs. lint at $0.13	$10.40
160 lbs. seed at $16.00 per ton	1.28
Value of the increased production	$11.68

Deducting from this the cost per acre ($3.99) for poison and labor, we get $7.69 as the profit, per acre, following six applications of the powdered arsenate to this variety.

EXPERIMENT F.

Seven Applications. Variety, Hawkins' Prolific.

The plat which received the applications of powdered arsenate was bounded on one side by an adjoining plantation, on the opposite side by a corn field, and on the other two sides by cotton which also received arsenate. The check plat was some little distance from the poisoned plat, the two plats of Experiment G intervening. Both poisoned and check plats were about equally exposed to the spring influx of hibernated weevils, but the check plat was upon land not quite as well drained as that on which the poisoned plat was located, and in addition the soil in portions of the check plat was of a "buckshot" nature. The poisoned plat was on soil containing a fair amount of sand, hence the increased yield in this experiment was greater than would have been the case had both plats been on the same kind of soil. This undesirable feature of the experiment was foreseen early in the season, but no more suitable situation could be found for it. The results may be considered for what they are worth. They really represent a comparison between the production of poisoned cotton on sandy soil, with that of non-poisoned cotton on a mixed "buckshot" soil, with both subjected to ruinous climatic conditions. (See page 269.)

The first six applications of the powdered lead arsenate were given this plat upon the same dates, and in the same amounts, as the applications to the poisoned plat in Experiment E. The seventh application was made on July 21st at the rate of 8.8

pounds per acre. The Champion dust gun was used and the applications made with care, as in all the other experiments. Below is a summary of all applications made to the poisoned plat of this experiment:

APPLICATION.	DATE.	Pounds Arsenate Per Acre.	Labor Required. (Hours.)	Cost of Arsenate Per Acre.*	Cost of Labor Per Acre.*
1st	June 9	1	1	$ .22	$ .08
2nd	June 16	1.2	1	.26	.08
3rd	June 24	2.46	2	.54	.16
4th	June 30	2.42	1⅞	.53	.15
5th	July 8	3.51	2⅛	.77	.17
6th	July 12	3.95	2	.87	.16
7th	July 21	8.8†	2 4-5†	1.94	.23
	Totals	23.34	12 4-5	$5.13	$1.03

Total cost for labor and poison, per acre $6.16

Square Infestation.

The square infestation in the two plats, as determined by weekly examinations, was found to be as follows:

DATE OF EXAMINATION	AVERAGE PER CENT OF SQUARES INFESTED	
	Poisoned plat	Non-poisoned plat
July 8	7.2	15.2
July 12	9	24
July 21	12.8	51.2
July 28	20	54
Aug. 4	62.4	87.6
Aug. 10	84	92

The foregoing table shows that the percentage of squares infested in the non-poisoned plat was much the greatest through the entire growing season. The manner in which relative square infestation forecasts relative production was explained on page 263. In all of our experiments we found that the greatest production occurred in the plats having lowest square infestation, and the lowest production in the plats having the highest percentage of square infestation. The difference between infestation in the two plats in this experiment, as shown by above table, was very marked; the difference in production in the two plats was equally pronounced.

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*Cost of arsenate calculated at $0.22 per pound and labor at $0.08 per hour, as in the preceding experiments.

†As the plants grow larger and bear a constantly increasing number of limbs and squares more of the powdered arsenate is required at each succeeding application. Generally speaking, more labor per acre is also required in making the applications properly as the plants get larger and larger.

Production.

The poisoned plat in Experiment F produced at the rate of 281.7 pounds seed cotton per acre; the check (non-poisoned) plat, at the rate of 79.8 pounds per acre. The yield of the poisoned plat, therefore, exceeded that of the non-poisoned by 201.9 pounds per acre. Finding the value of this increase in yield at $0.13 for lint and $16.00 for cotton seed, we have:

67 lbs. lint at $0.13	$8.71
135 lbs. seed at $16.00 per ton	1.08
Total value of increase	$9.79

Deducting from this $9.79 the cost ($6.16) of the seven applications, we find that a net profit of $3.63 per acre from use of the poison is indicated. Allowance must, however, be made for the difference in soil in the two plats, as already explained. At least a portion of the increase in production in the poisoned plat was due to the soil being more sandy than that in the check plat.

EXPERIMENT G.

Ten Applications. Variety, Toole's Early Prolific.

There is necessarily a limit to the number of applications of powdered arsenate which can be profitably made to a cotton field.

With each succeeding application the cost of poison and labor, which must be charged against the increased yield of cotton, becomes greater and greater. At the same time, also, the infestation by the boll weevil increases; rapidly in non-poisoned cotton, more slowly in the poisoned. If applications of the arsenate were continued through the entire season their cost would be certain to exceed the increased production resulting from the use of the poison. Their cost might even exceed the total value of the crop, even though the yield of the poisoned cotton might be much in excess of that from cotton receiving no arsenate at all. Just how many applications should be made in order to secure the maximum profit from use of the arsenate is, therefore, a vital question. For example: The application of poison to a field five times might sufficiently increase the yield to give a fair profit on the operation; yet, were ten or twelve applications made to the same field, the cost of poison and labor might easily exceed the value of the increased production, even though the latter were greater than the increase in production following the five applications. At the beginning of this experimental work we did not know whether the use of powdered arsenate could be made profitable under even the most favorable conditions. We therefore planned various experiments, involving from one to ten applications of the arsenate. The narrow margin of profit—or the absence of it—when the use of the powdered arsenate is carried to an extreme, is shown by this and the following experiment, in each of which ten applications were made to the poisoned plat.

The two plats of Experiment G were separated by a few extra rows of cotton of the same variety. These extra rows did not receive any poison.

The two plats had identically the same surroundings; each was bounded on two sides by cotton, on the third side by a corn field and on the fourth side by an adjoining plantation.

The first seven applications of the powdered lead arsenate were made to the poisoned plat of this experiment on the same dates, and at the same strength, as the seven applications made in Experiment F.

The eighth, ninth and tenth applications were made upon July 28th, August 4th and August 10th, respectively, the application being at the rate of 9.2 pounds on each of the dates named. Following is the summary of all applications of the powdered arsenate of lead made to the poisoned plat:

APPLICATION	DATE.	Pounds of Arsenate Per Acre.	Labor Required. (Hours.)	Cost of Arsenate Per Acre.*	Cost of Labor Per Acre.*
1st	June 9	1	1	$ .22	$ .08
2nd	June 16	1.2	1	.26	.08
3rd	June 24	2.46	2	.54	.16
4th	June 30	2.42	1 7/8	.53	.15
5th	July 8	3.51	2 1/8	.77	.17
6th	July 12	3.95	2	.87	.16
7th	July 21	8.8	2 4-5	1.94	.23
8th	July 28	9.2	4 1/8	2.02	.33
9th	Aug. 4	9.2	2 3/4	2.02	.22
10th	Aug. 10	9.2	2 3/4	2.02	.22
	Totals	50.94	22 2-5	$11.19	$1.80

Total cost per acre, for both labor and poison, ten applications.. $12.99

Thus do we see how the total cost of poisoning is swelled with each additional application after the plants attain a large size.

Square Infestation.

The relative percentage of squares infested in the two plats of this experiment, at different dates, is shown below:

DATE OF EXAMINATION	AVERAGE PER CENT OF SQUARES INFESTED	
	POISONED PLAT.	Non-poisoned plat
July 12	8.8	23.6
July 21	12.8	51.2
July 28	23	68
Aug. 4	86.4	89.2
Aug. 10	84.4	89.6

Production.

The poisoned plat in this experiment, that is, the plat which received the ten applications of powdered arsenate as above described, yielded at the rate of 392 pounds seed cotton per acre. The plat which received no poison yielded at the rate of 76 pounds per acre. The poisoned cotton, therefore, yielded 316 pounds, per acre, more than the non-poisoned. Ascertaining the value of this 316 pounds of seed cotton as in the previous experiments, we have:

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*Cost of arsenate calculated at $0.22 per pound, and labor at $0.08 per hour, as in the preceding experiments.

105 lbs. lint at $0.13	$13.65
211 lbs. seed at $16.00 per ton	1.69
Total value of increased production, per acre	$15.34

From the value of this increased production must be subtracted the cost, per acre, of poison and labor. This item amounted to $12.99, as shown above. This leaves a profit of only $2.35 per acre as the result of making ten applications of the poison, even though the actual production of the poisoned cotton was more than five times that of the non-poisoned. Doubtless the margin of profit would have been greater had the applications been discontinued earlier in the season.

EXPERIMENT H.

Ten Applications. Variety, Hawkins' Prolific.

This experiment was rather a peculiar one, in that the plat to which poison was applied was on a much poorer piece of land than the field which was reserved as a check and was also subjected to more severe boll weevil infestation.

The soil in the field (5 acres) which was selected for poisoning was somewhat of a stiff, pasty nature, retaining a certain amount of moisture in spite of adjoining ditches and bayous. This field was planted to cotton, on the tenant system, in 1908, and the entire field produced only about 100 pounds of seed cotton, despite the fact that there was practically no weevil infestation until late that year. In 1907 this field was in corn. During both 1907 and 1908 Messrs. Phillips Bros. noticed the peculiar pasty condition of the soil in this field, and its failure to drain properly. The field was also surrounded by many moss-covered trees and was only about a hundred yards distant from an adjoining plantation which was only partially cleared and which supplied abundant hibernating quarters for the boll weevils during the winter of 1908-09.

The adjoining field, which was used as a check, was located on the bank of Bayou Ciri, higher than the poisoned field, well drained and with soil decidedly sandy and mellow. Good hibernating quarters for the boll weevils were not as abundant in the immediate vicinity of this field.

These marked differences between the two fields were known to us at the beginning of the season and we purposely requested

Messrs. Phillips' permission to apply the arsenate to the poorest field, thus subjecting the poison to the severest possible test and giving to the check plat the benefit of all natural advantages. The experiment does not, therefore, represent a comparison of poisoned and non-poisoned cotton grown under the same conditions, but does present a comparison of poisoned cotton grown on poorly drained, stiff soil and subjected to severe weevil infestation, with non-poisoned cotton grown on well drained sandy soil in the absence of favorable hibernating quarters. This point should be kept in mind when studying the outcome of this experiment.

The land in both these fields was prepared for planting in the latter part of March, 1909, by rebedding with a turning-plow and pulverizing the soil as finely as possible. Just before planting the beds were run over with a small-toothed harrow. Both plats were planted to Hawkins' Prolific on April 5th.

As the season progressed there appeared to be little difference in the size of the plants in the two fields, but it was noticed that in wet weather the cotton plants on the stiff land shed forms and bolls to excess, while much less shedding occurred in the field on the sandy land.

Applications of Arsenate.

Following is the record of applications of powdered arsenate of lead given to the field located on the stiff soil:

APPLICATION.	DATE.	Pounds Arsenate Applied Per Acre.	Labor Required Per Acre. (One man.)	Cost of Arsenate Per Acre.*	Cost of Labor Per Acre.*
1st	June 9	1	1	$ .22	$ .08
2nd	June 16	1.2	1	.26	.08
3rd	June 24	2.4	1.9	.53	.15
4th	June 30	2.4	1.8	.53	.14
5th	July 8	3.5	2.1	.77	.17
6th	July 12	3.9	1.9	.86	.15
7th	July 21	8.8	2.9	1.94	.23
8th	July 28	9.2	4.1	2.02	.33
9th	Aug. 4	9.2	2.7	2.02	.22
10th	Aug. 10	9.2	2.7	2.02	.22
	Totals	50.8	22.10	$11.17	$1.77

Total cost, for arsenate and labor, per acre.....$12.94

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*Cost of arsenate calculated at $0.22 per pound and labor at $0.80 per day of ten hours.

The above table, as well as the table given in connection with Experiment G, illustrates how much arsenate is required after the fifth application is passed, and how the expense of using the poison is increased at a very rapid rate with each additional application after the fifth. See discussion of this point on page 331.

Infestation.

The following table gives the infestation from time to time in the poisoned plat, as well as that in the plat set aside for a provisional check. In comparing these percentages of infestation it should be remembered that the poisoned plat was exposed to much the heaviest spring infestation by reason of its being surrounded by moss-covered trees and other favorable hibernating quarters.

DATE OF EXAMINATION	POISONED PLAT.		NON-POISONED PLAT.	
	Average Number of Adult Weevils Per Acre.	Average Per Cent of Squares Infested.	Average Number of Adult Weevils Per Acre.	Average Per Cent of Squares Infested.
June 9	97		97	
June 16	54		33	
June 24		15.		11.2
June 30		14.		12.4
July 8		7.		25.2
July 12		35.		22
July 21		31.		40
July 28		48		60.8
August 4		77.6		83.2
August 10		96		95.6

The examinations made June 9th and 16th showed that the hibernated weevils were entering the poisoned plat at a greater rate than the check plat. This was to be expected on account of the superior hibernating quarters surrounding the former. The examination of squares on June 24th gave further indication of heavier infestation in the poisoned plat. However, during the first week in July the percentage of infestation in the poisoned plat went down, while that in the check plat took a decided movement upwards. On July 12th infestation in the poisoned plat exceeded that in the check, but this state of affairs was speedily reversed by further applications of the arsenate, and thereafter, until the end of the growing season, the infestation in the poisoned plat was lower than in the non-poisoned.

All other things being equal, the field showing the lowest square infestation during the growing season will produce the most cotton. Had these two fields been on the same kind of land, and under similar conditions, there is no question but what the poisoned plat would have given the heaviest yield.

Production.

The poisoned field, on the stiff land, produced 989 pounds of seed cotton, or 197.8 pounds per acre. The check field (5.27 acres), on sandy, well drained land, produced 1,595 pounds of seed cotton, or 302.6 pounds per acre. The production of the non-poisoned field was therefore 104.8 pounds per acre in excess of the production in the poisoned field. At first sight, this appears to indicate that the use of the powdered arsenate of lead was a failure. However, due allowance must be made for the difference in soil in the two plats and for the unfavorable conditions surrounding the poisoned field. Messrs. Phillips state that, as a result of their experience with these two fields, the one on the stiff land would normally produce not to exceed one-fourth as much cotton per acre as the field (check) on the sandy soil. If this be true, the normal production of the field which received poison, had it not been poisoned at all, would have been one-fourth that of the check field, or 76 pounds per acre. Its actual production was 197.8 pounds per acre. It therefore appears that the use of the arsenate of lead on the stiff land increased its production 121 pounds per acre. This 121 pounds seed cotton at $0.13 for lint and $16.00 for seed would be worth $5.87, or $7.07 per acre less than the cost of poisoning.

This method of arriving at the effect of the poison is somewhat devious and not entirely reliable, and as the two plats were under entirely different conditions we have not included this experiment in our statement (page 304) showing the average production of poisoned and non-poisoned cotton in the experiments.

This experiment, aside from indicating that ten applications exceed the limit of profit, holds a valuable lesson in that it shows that the powdered arsenate of lead cannot offset the disadvantages of stiff soil, poor drainage and excessive weevil infestation. That selected, well drained sandy land will always produce a better crop of cotton, without any poison, than will inferior land, no matter how heavily the powdered arsenate may be used, seems certain. It also indicates that a smaller profit—or no profit at all—may be expected from the use of powdered lead arsenate on lands that are unadapted to cotton growing under boll weevil conditions. (See footnote on page 275; also, page 309.)

EXPERIMENT AT WOODSIDE, AVOYELLES PARISH.

Eight Applications. Variety, King's Early Prolific.

This experiment, to our minds, was one of the most reliable and convincing of the entire series. Hailstorms, floods and hurricanes did not beset this experiment, as they did the ones at Lakeland, and climatic conditions were such that a fair production, boll weevil infestation excepted, was possible.

The weevil infestation in early spring was so excessively heavy that the ability of the powdered arsenate of lead to protect the cotton was tested to the utmost.

The experiment was located on the plantation of Dr. Gordon Morgan, about midway between the towns of Odenburg and Woodside, on the west side of the Atchafalaya River. The field in which the experiment was made was on alluvial soil, about one mile back from the river front and about one-half mile distant from the heavy timber and swamp land on the back part of the plantation. The soil was of a sandy nature, fairly well drained. The field was in cotton in 1908. The portion of the field to which the poison was applied was slightly higher than the portion which served as a check. Due allowance for this slight difference in drainage must be made in considering the productive capacity of the two plats but, as offsetting it in large degree, the poisoned plat was adjoined by a small bayou along which there were numerous moss-covered trees. No timber, or other good hibernating quarters, adjoined the check plat.

The most interesting and important feature of this experiment lay in the excessive spring infestation to which the cotton was subjected. During 1908 several hundred acres of cotton were grown in the immediate vicinity and so great was the damage by the boll weevil that cotton was entirely abandoned on the plantation and none grown in 1909 except the small area (about

4 acres) which was planted especially for this experiment.* The hibernated boll weevils, furnished by the several hundred acres of 1908 cotton, concentrated, in the spring of 1909, on the four acres of experimental cotton, it being the only available food for them in the neighborhood. At the time of the first poisoning adult weevils were so abundant that from 5 to 8 could be found on the largest plants and during June there appeared to be a constant influx of adult weevils which were still coming out of hibernation in the woods. The boll weevils were so abundant at this time that we found it necessary to guarantee the tenant a production of one-fourth bale per acre in order to prevent him from abandoning the crop—a guarantee that, in view of the heavy weevil infestation, appeared to be sheer recklessness. There is little doubt but what practically total destruction of the crop would have occurred had it not been for the use of the powdered arsenate. This view is concurred in by Dr. Morgan, who followed the experiment closely, and with much interest, during the season.

The field was planted to King's Early Prolific on March 30th, following good preparation of the soil. The rows were 4½ feet apart and the plants, after chopping out, were about 16 inches apart in the row. A few hills of "seppa," or sprout, cotton occurred here and there in the field. These were left standing, as their presence merely made the test of the poison all the more severe.

By June 15th the cotton plants were just beginning to put on the first few squares and it was decided to make the first application of the powdered arsenate of lead. Prior to the application, however, a careful count of the adult weevils present was made by examining several hundred-foot sections of rows in different parts of the field. In the portion set aside for poisoning an average of 468 weevils per acre was found; in the portion set apart for check plat, 194 per acre were found.

On the morning of June 16th the first application of powdered arsenate of lead was made to the poison plat at the rate of two-thirds of a pound per acre, a Champion dust gun being used for the work and pains taken to force the poison into the terminal buds with much force.

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*To Dr. Gordon Morgan we are indebted for his kindness in having this field planted for our use, as well as for much assistance and many courtesies shown us during the entire season.

The rate at which over-wintered weevils were entering the field at this time was indicated by examinations made on the morning of the 18th, 48 hours after poison was first applied. This examination showed 465 weevils per acre in the plat that had received the arsenate and 252 per acre in the check plat. In the non-poisoned cotton the number of weevils had increased in two days' time from 194 to 252 weevils per acre. The number of weevils present in the poisoned plat at the end of the 48 hours was practically the same as at the beginning. There is no doubt that the influx of weevils into the poisoned plat was fully as great as into the check plat, but the number killed by the poison very evidently offset the number entering the field, leaving the poisoned cotton with the same number of weevils at the time of the application.

From this date on there was a steady ingress of weevils into both plats until the bulk of the weevils were out of hibernation. It was not until after this influx of hibernated weevils ended, about July 5th, that we succeeded in reducing the rate of infestation in the poisoned plat.

Had the cotton plants been destroyed in this vicinity early the preceding fall, thereby killing the bulk of the weevils before they entered hibernation, there would have been a much smaller number of weevils to contend with in the spring and it is only reasonable to suppose that in such a case our first three applications of the arsenate would have reduced the infestation and permitted the plants to put on bolls from the start. A much larger increase in the crop would have resulted. As it was, the number of over-wintered weevils entering the field during the first three weeks after the plants began squaring was practically equivalent to the number that could be destroyed with the arsenate.

The following table gives the date and amount of each application to the poisoned plat. It should be remembered that all these applications were made with a dust gun (not by merely sifting the poison onto the plants), the success of killing the weevils with the powdered arsenate being based upon the principle of *forcing* the poison *into* the terminal buds with a powerful current of air.

APPLICATION	DATE.	Pounds Arsenate Per Acre.	Labor Required, One Man, Hours Per Acre.	Cost of Arsenate Per Acre.*	Cost of Labor Per Acre.*
1st	June 16	2-3	1 2-3	$.16	$.14
2nd	June 21	2 1-2	2	.55	.16
3rd	June 28	4 1-3	2 1-3	.95	.19
4th	July 5	6 2-3	4	1.47	.32
5th	July 12	6 2-3	3 1-3	1.47	.27
6th	July 19	8 1-3	2 2-3	1.84	.21
7th	July 26	8 1-3	2	1.84	.16
8th	Aug. 2	6 2-3	2 2-3	1.47	.21
	Totals	44 1-6	20 2-3	$9.75	$1.66

Total cost, for both poison and labor, per acre.................... $11.41

Weevil Infestation.

As stated above, an examination was made of each plat, to determine the number of weevils present, just before the first application of the powdered arsenate. Subsequent examinations were made about once a week. In the early part of the experiment weekly counts were made to determine the number of adult weevils present. As soon as squares were abundant enough the average percentage of infested squares in each plat was ascertained. When the plants attained large size, so that adult weevils were found with difficulty, the estimates of adult weevils per acre were abandoned and the percentage of infested squares noted until maximum infestation was reached. The results of these various examinations are given on following page.

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*Cost of arsenate of lead calculated at $0.22 per pound and labor at $0.80 per day of ten hours.

DATE OF EXAMINATION.	POISONED PLAT.		NON-POISONED PLAT.	
	Weevils Per Acre.	Per Cent of Squares Infested.	Weevils Per Acre.	Per Cent of Squares Infested.
June 15	468		194	
June 18	465		252	
June 21	155		136	
June 28	232		194	
July 5	329	40.2	348	40.2
July 12		35.2		39.6
July 19		10.8		35.6
July 26		7.2		32
August 2		24.4		42.4
August 9		72		83.2

The above table shows that the use of the powdered arsenate caused a steady reduction in the infestation of squares in the poisoned plat for three weeks following July 5th, the approximate date by which the influx of adult over-wintered weevils came to an end. Thereafter, while the square infestation increased in both plats, the extent to which this increase was retarded, where the arsenate was applied, is strikingly evident.

By September 2nd maximum infestation existed in both plats. Picking was also commenced on this date.

Production.

The two plats were measured on September 2, 1909, by Mr. W. R. Messick, Parish Surveyor of Avoyelles parish. The record of cotton picked from each plat was kept by the tenant, an intelligent negro, under the supervision of Dr. Morgan. The yield, in pounds of seed cotton per acre, was as follows:

Poisoned plat	533.7
Non-poisoned plat	130.2
Excess in yield, poisoned plat	403.5

Estimating the value of this increased production at $0.13 per pound for lint and $16.00 per ton for seed, as in preceding experiments, we find it to be worth:

134 pounds of lint at $0.13	$17.42
269 pounds of seed at $16.00 per ton	2.15
Total value of increase, per acre	$19.57

Deducting from the value of this increased production the cost of powdered arsenate used and the cost of labor for applying it, amounting to $11.41 per acre, as already shown, we find that a net profit of $8.16 per acre is indicated as the result of using the poison.*

Dr. Morgan thinks that a portion of the increase in production should be credited to the fact that the portion of the field receiving poison was somewhat higher than the non-poisoned part. To this we agree, but believe this slight advantage was largely, or entirely, offset by the proximity of moss-covered trees (good hibernating quarters) to the poisoned plat. We are also of the opinon that what little cotton was made in the check plat should be credited to the use of the arsenate in the adjoining plat. Adult boll weevils move about more or less and there is no reason why weevils wandering from the check plat to the poisoned one should not be killed in the latter. It seems very certain that, had no arsenate been applied to any portion of this field, the infestation would have been at its maximum during the entire season and no cotton would have been made in either plat. That no cotton at all could be made in this field was the expressed opinion

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*This experiment may be well used to illustrate to what extent the market price of cotton determines the amount of profit from using the powdered arsenate of lead. Thus, in the present experiment, if cotton were selling at $0.15 instead of $0.13, the increase in production (403.5 pounds per acre) of the poisoned cotton would be worth:

134 pounds lint at $0.15	$20.10
269 pounds seed at $16.00	2.15
Total	$22.25

Deducting from this the cost of poisoning ($11.41 per acre) we would have a profit of $10.84 per acre, instead of $8.16 per acre.

With lint selling at 12 cents and cotton seed at $14.00 per ton the value of the increase in production would be $17.96, or $6.55 over and above the cost of producing it.

With the price of cotton at 10 cents and seed at $12.00, the value of the 403.5 pounds increase in production would be $15.01, or only $3.60 per acre above the cost of the poison and labor required to bring about this increase in production.

With cotton selling at 7 cents and seed at $8.00 per ton, the value of the increased production would be $10 45 per acre, or less than what the poison and labor cost. With prices at this level the poisoning operations, in this experiment, would have resulted in a loss.

To a lesser extent, the price paid for the powdered arsenate of lead, and the price paid for labor, affect the amount of profit derived from using this poison.

of all who saw how abundant the weevils were in the early part of June.

EXPERIMENTS AT SHAW, CONCORDIA PARISH.

Through the courtesy and assistance of Mr. W. L. Shaw, a prominent cotton planter of many years' experience in Concordia Parish, we were enabled to make two interesting experiments upon his plantation, located at Shaw, La.

The work included two separate experiments, located in fields about one-half mile apart. They differed from each other slightly with respect to surrounding hibernating quarters for the weevils, in the variety of cotton experimented on and in the fact that seven applications of the powdered arsenate of lead were made in one experiment and five in the other.

Both experiments were on sandy land, in places mixed with a small amount of "buckshot" or stiff soil. All were well drained by the excellent system of open ditches maintained on the plantation. The experimental fields were about one-half mile from the Mississippi River levee, and about a quarter of a mile from the swamp in the rear.

The application of the poison was under the personal supervision of the junior author. The planting of the crop and its care and cultivation were under the personal supervision of Mr. F. W. Eberhart, the plantation superintendent. Mr. Eberhart also kept the record of all cotton picked from the several plats. The fields were measured by Mr. S. N. Garrett, a civil engineer of New Roads, La., and a duly certified diagram of the experimental areas filed by him in the office of the State Crop Pest Commission at Baton Rouge.

EXPERIMENT A.

Seven Applications. Variety, Keno.

The land on which this experiment was located was overflowed by water from Red River during 1908, this stream being but a few miles from Mr. Shaw's plantation and unleveed. Accordingly no crop was grown on this land in 1908, although cotton was grown on other parts of the plantation. The field was broken up in August, 1908, and again in January, 1909. The land was rebedded in the latter part of February and planted to the variety Keno on March 14th, with the rows seven feet apart.*

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*The field was planted before any arrangements were made for an experiment at Shaw. We believe that, had the rows been nearer together, the production per acre would have been greater.

Situations in which the boll weevils could hibernate successfully were by no means lacking around this field. On one side the plats were adjoined by a deep bayou, its banks fringed with moss-covered trees, vines, and an undergrowth of brush and weeds. On the opposite side the field was approached to within one-fourth mile by the famous Bourgeois Swamp, with its tangle of vines and moss-covered trees.

The plat to which the poison was applied consisted of thirty-one rows, all running straight back from the bayou. The check, or non-poisoned, plat used for comparison consisted of the adjoining thirty-one rows. Cotton of the same variety continued in parallel rows for a considerable distance on either side of the two plats. The rows were of the same length in both plats, the soil was of the same character, the stand was perfect, the surroundings were identically the same, and both were equally well drained. In all of our experimental work we have never seen two plats of cotton that were as equally matched and as perfectly alike in every respect. The results may therefore be considered as reliable and trustworthy.

As in all of our experiments with the powdered arsenate, the poison was applied only with the Champion dust gun, the poison being forcibly injected into the buds, and, as much as possible, into the involucres of the squares themselves.

The various applications of the arsenate made to the poisoned portion of the experiment are sufficiently described below.

APPLICATION.	DATE.	Pounds Arsenate Per Acre.	Labor Required, Hours Per Acre, One Man.	Cost of Arsenate Per Acre.*	Cost of Labor Per Acre.*
1st..	June 8	1.2	1.6	$.26	$.13
2nd	June 15	1.8	1.3	.40	.10
3rd	June 22	5.5	1.6	1.21	.13
4th	June 29	7.6	3.2	1.67	.26
5th	July 7	10.3	5.3	2.27	.42
6th	July 13	10.8	5	2.37	.40
7th	July 20	11	4.4	2.42	.35
	Totals	48.2	22.4	$10.60	$1.79

Total cost per acre, for labor and poison $12.39

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*Cost of powdered arsenate calculated at $0.22 per pound and cost of labor at $0.80 per day of ten hours.

Weevil Infestation.

The usual observations were made, during the growing season, to determine the relative infestation in the two plats of the experiment. The results of these examinations are given in the table below:

DATE OF EXAMINATION	POISONED PLAT.		NON-POISONED PLAT.	
	Adult Weevils Per Acre.	Average Per Cent of Squares Infested.	Adult Weevils Per Acre.	Average Per Cent of Squares Infested.
June 8*	25		25	
June 15	62	19.6	50	32.8
June 22		49.8		54.4
June 29		15.6		30.8
July 7		29.6		36
July 13		24.8		37.2
July 20		24.4		50
July 27		30.8		47.2
August 3		79.2		90.4

By August 30th the cotton in both plats had ceased "making" and the older bolls were opening rapidly.

The marked difference in square infestation, as shown by the above examinations, illustrates the extent to which the use of the powdered arsenate retarded weevil increase in the poisoned plat. These figures are all the more instructive because of the fact that there were no local conditions whatever which might tend to increase or retard the infestation in either of the plats; both were surrounded by identically the same conditions. That this appreciable difference in square infestation from June 15th to the middle of August did permit more bolls to make and mature in the poisoned plat, than in the non-poisoned, is demonstrated by the final yield, given in the following paragraph.

Production.

The area of the poisoned plat, as shown by Mr. Garrett's measurements, was 1.81 acres. The area of the non-poisoned plat was the same. The yield, as kept by Mr. Eberhart, was as follows:

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*Examination made *before* the first application of powdered arsenate.

Poisoned plat	1,254 pounds seed cotton
Non-poisoned plat	620 pounds seed cotton

Dividing each of these totals by the acreage of each plat, we find the yield per acre was:

Poisoned plat, yield per acre	692.7 pounds seed cotton
Non-poisoned plat, yield per acre	342.5 pounds seed cotton

The cotton which received the seven applications of powdered arsenate of lead therefore yielded 350.2 pounds seed cotton more per acre than did the non-poisoned.

Estimating the value of this 350 pounds seed cotton at $0.13 for lint and $16.00 per ton for seed, we find it to be worth:

117 pounds lint at $0.13	$15.21
233 pounds cotton seed at $16.00	1.86
Value of increased production	$17.07

In order to arrive at the profit from the use of the poison, we must deduct from this $17.07, the cost of the powdered arsenate of lead and the labor of applying it, amounting to $12.39 per acre, as shown on page 294. This leaves us a *net* profit of $4.68 per acre after paying for the poison and all expenses incidental to its use.

Had the cotton in this experiment been of an early-maturing variety, so that it could have taken full advantage of the opportunity to put on bolls while being protected by the arsenate during June and July, the production would have been larger, the difference in yield between the poisoned and non-poisoned cotton would have been correspondingly increased and the profit made greater.

EXPERIMENT B.

Five Applications. Variety, Simpkins.

This experiment was located about one-half mile from Experiment A, described above. The two plats were located in the center of an open field and no other crops were near except a small patch of cotton to the east of, and adjoining, both plats. The land was overflowed in 1908 and no crop was grown on it that year except peas. These were mowed late in the season.

Hibernating conditions for boll weevils were rather favorable in the vicinity of these plats, for they were located well towards the back of the plantation, only about four hundred yards from the large swamp.

The land was plowed in January, rebedded in March and planted to Simpkins cotton on April 2nd. A good stand was secured in both plats.

Applications of the powdered arsenate of lead were made to the poisoned plat as follows:

APPLICATION.	DATE.	Pounds Arsenate Per Acre.	Labor Required, Hours Per Acre, One Man.	Cost of Arsenate Per Acre.*	Cost of Labor Per Acre.*
1st	June 8	1.2	1.7	$ .26	$ .14
2nd	June 15	1.8	1.3	.40	.10
3rd	June 22	5.5	1.6	1.21	.13
4th	June 29	7.7	3.2	1.69	.26
5th	July 7	10.3	5.3	2.27	.42
	Totals	26.5	13.1	$5.83	$1.05

Total cost per acre, for arsenate and labor $6.88

Weevil Infestation.

The usual records of weevil infestation were made in the case of both plats, the results of these examinations being given below:

DATE OF EXAMINATION	POISONED PLAT.		NON-POISONED PLAT.	
	Adult Weevils Per Acre.	Average Per Cent of Squares Infested.	Adult Weevils Per Acre.	Average Per Cent of Squares Infested.
June 8	152		152	
June 15	45	41.6	45	45.6
June 22		17.2		40.4
June 29		2.8		24.4
July 7		12		35.6
July 13		19.2		29.6
July 20		41.2		45.6
July 27		66		72
August 3		90.8		93.2
August 10		97.2		98.4

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*Cost of arsenate calculated at $0.22 per pound and labor at $0.80 per day of ten hours.

By the latter part of August enough bolls were open for picking to be commenced, and by August 30th very few squares were appearing on the plants, these few being punctured by the weevils.

Production.

Mr. S. N. Garrett's measurements of the two plats showed that the poisoned plat contained 1.94 acres and the non-poisoned plat 2.65 acres.

Mr. Eberhart's memoranda of the different pickings showed that the poisoned plat produced 2,265 pounds seed cotton and the non-poisoned plat 1,503 pounds.

From these figures we find the production per acre to have been:

Poisoned plat	1,167.5 lbs. seed cotton per acre
Non-poisoned plat	567.2 lbs. seed cotton per acre
Increased production, poisoned plat,	600.3 lbs. seed cotton per acre

We thus see that five applications of the powdered arsenate, properly made, resulted in more than a doubling of the crop. However, before assuming that the *profit* from the crop was doubled by the poisoning operations, we must find the value of this 600 pounds increase in production and deduct from it the cost of the five applications of poison.

Calculating the value of the increase at the rate of 13 cents per pound for cotton and $16.00 per ton for seed, we find it to be worth:

200 lbs. lint at $0.13	$26.00
400 lbs. cotton seed at $16.00	3.20
Total value of increased production	$29.20

By deducting from this the cost of the poison and labor required for making the five applications, amounting to $6.88, as shown, we find that a net profit of $22.32 per acre followed the use of the powdered arsenate of lead in this experiment.

EXPERIMENTS AT LOBDELL, WEST BATON ROUGE PARISH.

Arrangements were made, early in the season, for experiments on the place of Mr. John Speeg at Lobdell. An agreement was entered into with Mr. Speeg whereby the Crop Pest Commission was to furnish all the powdered arsenate of lead used in the experiments. The Commission was also to pay for the surveying of the plats. In return for these favors Mr. Speeg agreed to keep a record of the exact amount of seed cotton picked from each and every plat. All cotton and seed produced on the experimental areas became, of course, the exclusive property of Mr. Speeg.

Two excellent fields were selected for the experimental work and the junior author made weekly trips to Lobdell to supervise the applications of the poison.

The usual examinations to determine weevil infestation in the poisoned and check plats were made from time to time, and it was generally observed, as in the other experiments, that the weevil infestation was lightest in the poisoned cotton, indicating a prospective increase in production as a result of the arsenate being used.

We are, unfortunately, unable to report the practical outcome of these experiments, for the very good reason that the owner of the place failed to keep his part of the agreement and failed to keep an accurate record of production when the cotton was picked. Mention of these experiments is here made mainly for Mr. Speeg's benefit.

EXPERIMENT AT MANSFIELD, DE SOTO PARISH.

Five Applications. Variety, "Improved Triumph."

The experiment at this point was made in its entirety by Mr. Allen R. Roach, a planter who has been successful in making a good crop of cotton, despite the boll weevil, every season during the past five years. His farm is located about four miles northeast of Mansfield, on rolling upland which is interspersed with small creek bottoms. Mr. Roach had carried out a similar experiment under our direction in 1908, had studied carefully the principles upon which we hoped to profitably poison the weevil with the powdered lead arsenate, and was therefore particularly competent to take hold of the undertaking himself and use the powdered arsenate successfully on his own crop.

At our request, Mr. Roach very kindly agreed to arrange his test of the poison in such a way that a strict comparison could be made between the cotton treated with the arsenate and cotton not so treated. To this end the land on one side of a small creek was selected as the field to which poison would be applied and the land on the opposite side of the same creek planted in the same variety to serve as a check. Most of the land was creek bottom and the amount of high land in the poisoned portion was equalled by a similar amount in the portion used for a check plat.

Mr. Roach has always industriously carried out every practical recommendation for destruction of the weevils. It was, therefore, not surprising to learn that all cotton plants on Mr. Roach's farm had been cut down and burned before November 10th, 1908. This, of course, very materially reduced the number of weevils present in the spring of 1909 and increased, at the same time, the opportunities for making successful use of the powdered arsenate. We have pointed out, on a preceding page, how early fall destruction of the cotton plants operates to increase the effectiveness of the powdered arsenate of lead the following spring.

In the experiment made by Mr. Roach we have an excellent illustration of the combined effect of destroying the boll weevils in the fall, by early destruction of the plants, and further destruction of them in spring and early summer by the use of the powdered arsenate of lead. We believe that much of Mr. Roach's success with the arsenate was directly due to his action in destroying all cotton plants on his farm early the preceding November.

The land was deeply plowed early in January and rebedded in March. Prior to planting, high grade acid phosphate was applied at the rate of 200 pounds per acre. On April 10th the plats were planted to "Improved Triumph," a variety developed by Mr. Roach through succeeding years of careful selection from the well-known Mebane Triumph.

The cultivations given the cotton in both plats were shallow and frequent.

The exact measurements of the plats used in Mr. Roach's experiment were not taken until October, when they were surveyed by Mr. C. M. Robinson, C. E., of Mansfield, and certified records thereof filed with the Crop Pest Commission. The field to which Mr. Roach applied the powdered arsenate of lead contained, according to Mr. Robinson's survey, 9.61 acres. Two other fields, containing respectively 4.98 acres and 6.26 acres, located on the opposite side of the creek, were used by Mr. Roach as checks upon the poisoned plat.

Applications of the Powdered Arsenate of Lead.

Mr. Roach did not know the exact area of the field to which he was applying the poison, but having had experience in its application the preceding year, he was enabled to gauge the rate of application with considerable accuracy.

Mr. Roach reported making applications to the field as follows:

Application	Date	Rate Lbs. Arsenate per acre
1st	May 26	2
2nd	June 2	2
3rd	June 14	4
4th	June 16	4
5th	July 22*	5

From the foregoing we see that Mr. Roach used approximately 17 pounds of the arsenate, worth (at $0.22 per pound) $3.74 per acre.

We have not been furnished with a memorandum of the exact time required for making these applications, but on the assumption that two hours were required per acre, for each application—a very liberal estimate indeed—10 hours labor would be also chargeable against the production on each acre. Estimating the cost of this labor at the price which was paid for labor in our other experiments, $0.80 per day, it would amount to approximately $0.80. Adding this to the cost of the poison used. we see that the total expense of the five applications made by Mr. Roach did not exceed $4.54 per acre.

Weevil Infestation.

Mr. Roach, being a busy farmer, did not concern himself particularly with the extent of weevil infestation. However, on July 21st Mr. C. W. Flynn, Assistant Entomologist of the Commission, visited the experiment and made an examination and count of squares in both the poisoned and non-poisoned fields.

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*The long interval elasping between the fourth and fifth applications was due to the fact that Mr. Roach had expected to make only four applications, but later, on our advice, decided to make the fifth.

He found that an average of 50.4 per cent. of the squares in the poisoned plat was infested and 61 per cent infested in the check plats.

Mr. Flynn also estimated that there was from five to ten per cent more grown and half-grown bolls on the plants in the poisoned plat than on those in the check.

Production.

Under date of October 18th, 1909, Mr. Roach wrote as follows regarding the production:

"I have just finished picking the poisoned and non-poisoned cotton, with the following results:

' Poisoned	12,063 lbs. seed cotton
"Non-poisoned	9,072 lbs. seed cotton"

Computing the production per acre from the above weights and from the areas of these fields as determined by Mr. Robinson, we find the production to have been:

Poisoned plat	1,255.25 lbs. seed cotton per acre
Non-poisoned plats	807.11 lbs. seed cotton per acre

Profit.

Deducting the production of the check plats from that obtained in the poisoned plat we find that the production of the latter exceeded the former by 448.14 pounds seed cotton per acre.

Estimating the value of this increase at $0.13 for lint and $16.00 per ton for seed, as in preceding experiments, we find it was worth:

149 lbs. lint at $0.13	$19.37
299 lbs. seed at $16.00	2.39
Total value of increased production	$21.76

To arrive at the profit following the use of the arsenate it is necessary to deduct the cost of the poison and its application, already estimated at $4.54. This leaves a net profit of $17.22 per acre as the result of five applications of powdered arsenate of lead in this experiment.

SUMMARY OF THE EXPERIMENTS.

In the following table we summarize the important facts relative to each of the foregoing experiments. For other details than those given in this table, the reader should refer to the pages describing each experiment in detail:

TABLE III.

Summary of Field Experiments with Powdered Arsenate of Lead.

EXPERIMENT.	Number of Applications Powdered Arsenate.	Total Number of Pounds Arsenate Used Per Acre.	Cost of Poisoning Per Acre.*	Yield, lbs. Seed Cotton per Acre.		Net Profit† per Acre From the Use of Powdered Arsenate of Lead.	Experiment Fully Described on Pages:
				Poisoned Cotton.	Non-poisoned Cotton—Same Variety, etc.		
Mansfield, 1908	1	1	$ .42	1049	993	$ 2.00‡	254
Lakeland A, 1909	2	2.2	.64	246.3	82.1	7.34	269
Lakeland B	3	4.7	1.33	485.7	180.3	13.55	272
Lakeland C	4	7	2.02	208.7	161.6	.27	274
Lakeland D	5	10.6	2.96	672.7	127.9	23.54	275
Lakeland E	6	14.5	3.99	342.9	103.1	7.69	277
Lakeland F	7	23.3	6.16	281.7	79.8	3.63	578
Lakeland G	10	51	12.99	392	76	2.35	280
Lakeland H	10	50.8	12.94	198	no "check"	--7.07§	283
Woodside	8	44	11.41	533.7	130.2	8.16	287
Shaw A	7	48	12.39	692.7	342.5	4.68	293
Shaw B	5	26.5	6.88	1167.5	567.2	22.32	296
Mansfield 1909	5	17	4.54	1255.3	807.1	17.22	299

Owing to the many factors which may cause a variation in the production of adjacent pieces of land, the results of any one experiment cannot be taken as conclusive. It is only when many different experiments are considered together that one is enabled to draw reliable conclusions. We have made as many experiments with the powdered arsenate of lead the past season as our funds and time would permit, and while even more data upon the use of the powdered arsenate as a boll weevil poison is desirable, we think that the results of our experiments, as a whole, prove conclusively that the production of cotton can be very materially increased by its use. The following table gives a ready comparison of the poisoned and non-poisoned cotton in all of our experiments, with the exception of "Lakeland H," in which a true check was not provided.*

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*Includes the cost of labor for applying the arsenate, as well as the cost of the powdered arsenate of lead itself.

†By "net profit" is meant the value of the increased production, after deducting the cost of the powdered arsenate of lead and of the labor for applying it.

‡The value of the increased production in this experiment was computed at $0.10 per pound for lint and $18.00 per ton for seed. If the value of the increased production were estimated on the basis of $0.13 for lint and $16.00 for cotton seed, as has been done in the case of the 1909 experiments, the profit in this experiment would have been $2.59 per acre, instead of $2.00 per acre.

§That is, the estimated value of the extra cotton produced, by the use of the poison, was $7.07 less than the cost of poisoning. See description of this experiment on page 283.

The average production of all the experimental cotton to which the powdered arsenate was applied was 673.8 pounds seed cotton per acre; the average of all the non-poisoned cotton, 392.6 pounds per acre. In other words, the average production was increased by something over 71 per cent as a result of using the powdered arsenate of lead.

TABLE IV.

Acreage and Production of Poisoned and Non-Poisoned Cotton, All Experiments.

EXPERIMENT.	FIELD TREATED WITH POWDERED ARSENATE OF LEAD.		SIMILAR FIELD NOT TREATED ("CHECK FIELD.")	
	Acres.	Total Production, Pounds Seed Cotton.	Acres.	Total Production, Pounds Seed Cotton.
Mansfield, 1908	4.83	5068	4.71	4682
Lakeland A	4.10	1010	4.26	350
Lakeland B	3,29	1598	4.37	788
Lakeland C	3.32	693	4.40	711
Lakeland D	2.13	1433	2.86	366
Lakeland E	4.71	1615	5.13	529
Lakeland F	3.82	1075	4.02	305
Lakeland G	3.52	1380	2.77	211
Woodside	3.05	1628	0.79	104
Shaw A	1.81	1254	1.81	620
Shaw B	1.94	2265	2.65	1503
Mansfield, 1909	9.61	12063	11.24	9072
Totals	46.13	31082	49.01	19241

Average production, all cotton poisoned with powdered arsenate of lead. 673.8 lbs. per acre.

Average production, all cotton not treated with powdered lead arsenate, 392.6 lbs. per acre.

Average increase in production, per acre, 281.2 lbs., or 71 per cent.

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*See full discussion of this experiment on page 283.

NUMBER OF APPLICATIONS AS RELATED TO PROFIT.

The question of vital importance to the farmer is not: "How many or how few applications of the powdered arsenate of lead can be made with profit?" The question to be considered is: "How many applications will give the *greatest* net profit?"

We have already shown how only one or two applications do not kill enough boll weevils to materially increase the crop. We have also called attention to the fact that, beyond a certain point, each additional application adds heavily to the bill of expense for poison and labor. If carried to an extreme the cost of poison and labor will more than consume the value of the extra cotton produced as a result of using the powdered arsenate.

More experiments are necessary before we will be able to say what number of applications, one season with another, will return the greatest profit. Conclusions from the foregoing table, as to how many applications can be made to best advantage, are rather hazardous for the reason that these experiments were made in different localities and under varying local conditions. It is at once noticed, however, that the experiments yielding the highest net profit were those in which five applications were made to the poisoned plats of the experiments.

EARLY FALL DESTRUCTION OF THE COTTON PLANTS A NECESSARY CONDITION TO SUCCESSFUL USE OF THE POISON.

Experiments and observations made at various points have shown how favorable the climatic conditions are in central and southern Louisiana for the rapid multiplication of the boll weevils. The hibernation experiments made at Mansura, Avoyelles Parish, during 1908-09 also revealed the fact that these same climatic conditions, coupled with excellent hibernating quarters, permit an extraordinarily high percentage of the weevils to survive the winter.*

It therefore frequently happens that adult boll weevils are so abundant in the cotton fields about June 1st that they could destroy many times the number of squares that are actually put on by the young cotton plants. That such an excess of adult weevils at the beginning of the season operates to reduce the good resulting from the use of the powdered lead arsenate goes without saying. Let us suppose, for example, that 200 weevils per acre are sufficient to destroy all of the squares which are put on by the plants during May and June, but that 1,200 per acre are actually present. If we apply the powdered arsenate of lead and if it kills 75 per cent of all weevils present, there will still remain 300 weevils per acre, or more than enough to destroy all the squares anyhow. On the other hand, let us suppose that destruction of the cotton plants early the preceding fall has so reduced the number of hibernated weevils that only 100 weevils per acre are present in the fields when the first squares appear in spring. If the powdered arsenate be applied, causing a mortality of 75 per cent, as before, only 25 weevils per acre will remain to attack the crop. Twenty-five is only one-eighth as many as 200 and if the latter number of weevils is required to accomplish destruction of all squares, the 25 will destroy but one-eighth of the fruitage, permitting the other seven-eighths to develop into bolls.

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*The results of these experiments are published in Circular 31 of the Commission. This Circular may be had on application.

That early fall destruction of the cotton plants does reduce the number of hibernating weevils to at least one-twelfth the normal number surviving the winter is no theory; it has been proven by actual observation.*

It is easily possible that the number of over-wintered weevils present in the spring may be so great that applications of the powdered arsenate of lead cannot appreciably increase the crop. The farmer cannot therefore neglect early fall destruction of the cotton plants under the impression that he can make up for it by using powdered arsenate of lead the following spring and summer. On the contrary, reduction of the weevils by early fall destruction of the cotton plants is a necessary precedent to success with the arsenate in connection with the following crop.

If the reader will carefully study our account of the Woodside Experiment (page 287) he will see how applications of the powdered arsenate for three weeks' time failed to reduce the number of hibernated boll weevils to the point where bolls could be put on by the plants.

It is also significant that our most successful experiments with the powdered arsenate of lead were all located on plantations where fall destruction of the cotton plants occurred the preceding fall. The Mansfield Experiment of 1909, showing a net profit of $17.22 per acre as a result of using the arsenate, was on a farm where all cotton plants were completely destroyed before the 10th of the preceding November. The experiment designated as "Lakeland D," showing a net profit of $23.54 per acre from the use of the arsenate, was, along with other experiments, located on a plantation where all cotton plants were destroyed the preceding fall and ditch banks, bayou banks and headlands thoroughly cleaned early the preceding December. At Shaw, La., where Experiment B showed a net profit of $22.32 per acre, the cotton plants on the major part of the plantation were completely destroyed by the overflow of 1908—which amounted to an extremely early fall destruction of them.

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*See Circular No. 31, page 176.

OTHER FACTORS.

At first sight it would appear that the use of the poison is a very simple matter and that the results secured depend alone on the efficacy of the powdered arsenate. Such is not the case, however, for we find that various factors operate to increase or decrease the amount of cotton made by the use of this poison. Mention of these factors will not be out of place at this point.

Varieties.

That the variety of cotton has considerable to do with the success following the use of the powdered arsenate is evident. Generally speaking, a variety of cotton which fruits freely and matures early in the season will benefit far more from the poison than will a late maturing variety. This is true for the reason that maximum infestation is ultimately reached in the poisoned cotton, no matter how much arsenate is applied, and it is during the period that the arsenate is retarding weevil increase that the crop must be made. During this period a late-maturing variety makes but little fruit, while an early-maturing variety takes full advantage of the protection afforded it by the poison and puts on bolls rapidly. Again do we see that a return to the old methods of cotton culture is impossible, no matter how successful the use of the powdered arsenate may prove to be. The early planting of a quick-maturing variety and its subsequent perfect cultivation, to hasten growth and fruitage, are absolutely necessary to success with the powdered arsenate.

The use of the powdered arsenate does not permit the farmer to neglect or ignore any step in the "cultural method," as heretofore advocated. On the contrary, every operation required by the improved cultural methods—fall destruction of the cotton plants included—only serves to make this new poison all the more effective. The powdered arsenate of lead seems to give us one more means of reducing the weevils in number, but not a "panacea" which will permit us to neglect other precautionary measures.

It is not impossible that among the earliest maturing varieties there are some with which the use of the powdered lead arsenate will prove more profitable than with others. In the experiments at Lakeland, where conditions in all plats (except in H) were practically alike, there was a marked difference in the increased production obtained by the use of the powder on different varieties. Thus Experiment C, variety Peebles' Chosen, showed a profit of but $0.27 an acre from the use of the arsenate, while the Rublee's Anti-Boll Weevil Cotton, in the plat adjoining (Experiment D), showed a profit of $23.54 per acre from its use. Whether the variety of cotton had anything to do with this marked difference in the results of poisoning, we are unable to say, having no other experiments with either of these varieties. These two varieties, however. are of two very distinct types, the Rublee's being of a "limbless" type and the Peebles' of the ordinary or spreading type. It seems not unlikely that applications of the poison to cottons of the limbless type can be made more effective, owing to the smaller area which must be covered, than to the ordinary type of cotton. On this feature of the problem much more experimental data is required.

Fertilizers.

The question of fertilizing the crop also enters more or less into the question of profit derivable from the use of the powdered arsenate. Other things being equal, the cotton which is properly fertilized will put on the most fruit prior to time of maximum infestation. Likewise, if the infestation in such cotton be retarded by the use of the poison the increase in production will be greater than if no fertilizer is used. Here again a large field is opened for careful experimental work.

Character of Soil Selected for the Crop.

Closely related to the question of fertilizing, are the subjects of soil, drainage and natural fertility. Any condition which tends towards rapid growth and early fruitage of the cotton plants operates to increase the profit derived from using the powdered arsenate of lead. Cotton plants on a poorly drained, stiff soil cannot put on fruit rapidly during the period in which they are protected by the applications of the arsenate. Hence we find that very little increase in production follows the use of this poison when applied to cotton on stiff, wet land. Sandy, mellow soil, on the other hand, permits the crop, if planted early, to put on squares and bolls with great rapidity during May, June and the early part of July, while it is still possible to retard weevil infestation with the powdered arsenate. It is on such lands that we have obtained the highest profit from proper and intelligent use of the arsenate.

The most fortunate thing in connection with our discoveries, as to what can be accomplished with this poison, is that its use does not call for any modification of the improved cultural methods as now carried out by all progressive and successful cotton planters in the boll weevil section. The use of the poison, therefore, becomes an adjunct in the production of the crop, not a method which supersedes those now in use.

Rains.

On the extent to which occurrence of rain shortly after applying the arsenate influences its effectiveness, we have very little data. If the powdered arsenate of lead is applied to cotton which is damp from dew, or from a recent shower, the poison adheres in large quantity, and if thoroughly dried subsequent rains wash it off but slowly. It is not the arsenate adhering to the foliage which destroys the weevils; it is the arsenate which has been forced *into* the terminal buds, with the current of air, which does the effective work. Heavy, pouring rains will no doubt remove much of the poison deposited between the leaves of the terminal buds and thereby reduce the value of the application. A very large amount of experimental work will have to be done, with reference to the relationship existing between time and amount of rainfall and effectiveness of the arsenate.

Heat.

Dry, hot weather, which will cause a high mortality among the weevil larvæ in fallen squares, also contributes to the success of the powdered arsenate. Any factor which reduces the number of weevils contributes towards an increase in the amount of cotton produced. The benefits following the destruction of weevil larvæ by extreme summer heat are well known to all planters. A further reduction of weevils, at the same time, by the use of powdered arsenate of lead, must also prove beneficial. Only one of our experiments the past year, the one at Mansfield, was subjected to severe drouth. With 17 pounds per acre of the powdered arsenate, it yielded a higher margin of profit than many other experiments where a much larger amount of the poison was used. We may safely anticipate that the use of the powdered arsenate will be followed by greatest net increase in the crop in relatively dry seasons and in localities where the rainfall during the growing season is not excessive.

Parasites.

Inasmuch as the future natural control of the boll weevil is supposed to be dependent upon the increase of its parasites and natural enemies, it is not amiss to consider what effect the use of powdered arsente of lead will have upon these small, but mighty, friends of the farmer. The parasites, for the most part, infest the eggs, larvæ and pupæ of the boll weevil. The powdered arsenate does not destroy any of these weevil stages; it is fatal to the adult weevils only and it therefore occupies a field of usefulness quite distinct from that occupied by the parasites. There is no danger of the parasitic larvæ being destroyed by reason of their infesting weevils killed by the poison, for they do not infest the adults. We can see no way in which the parasites can be reduced in numbers by the powdered arsenate being used. On the contrary, there is every indication that the good work done by the parasites will be augmented by the use of the arsenate for destruction of the boll weevils. We have called attention to the fact that any factor which reduces the weevils in number contributes directly to the effectiveness of the poison. If a large proportion of the weevils be destroyed by parasites, a correspondingly smaller proportion will remain for the poison to destroy. On the other hand, a reduction in the number of boll weevils present by the use of the powdered arsenate, will have the effect of concentrating the existing parasites upon the progeny of the remaining weevils.

We can foresee no outcome other than that the increase in parasites will increase the effectiveness of the arsenate and the size of the crop, and that, conversely, use of the powdered arsenate will be followed by enhanced good accomplished by the parasites.

Other Cotton Insects.

The powdered arsenate of lead is as deadly to many other insects as it is to the boll weevil. Applications as heavy as those made in our experiments would not fail to destroy practically all boll worms, and the protection afforded the cotton plants against such insects as the square-borer, leaf-worm, brown Colaspis, cowpea pod-weevil and grasshopper would be well-nigh perfect. When any of these insects are present in considerable numbers, in addition to the boll weevils, the profit from using arsenate of lead will be increased, but never decreased, by their presence. Fortunately, in none of our experiments were boll worms or leaf-worms present in appreciable numbers, even in the non-poisoned plats, hence we know that the increased production secured was due to the effect of the arsenate upon the boll weevil and not upon other cotton-infesting insects.

Frequency of Applications.

The question as to how frequently the applications of the powdered lead arsenate should be made, in order to secure the best results, is a question upon which we have no data whatever. Our decision to make the applications a week apart, in the foregoing experiments, was purely an arbitrary decision. There was no particular reason why this interval was adopted except that it permitted us to visit each experiment once a week and supervise the application. In making these experiments we purposely varied the number of applications and used different varieties of cotton, but we could not have added another variable factor without rendering the results uncertain.

Future experience may show that the applications should be made somewhat oftener than once a week. This will probably prove true for the reason that a determined attack on the overwintered weevils, before they have produced progeny, is more effective in protecting the crop than the destruction of a much greater number of them after breeding is well under way.

This has been our first season of practical field work with the powdered arsenate of lead. When we decided to make the applications a week apart, we were merely guessing at the interval which should separate them. Whether a larger, or smaller, profit would follow from more frequent applications is a point still to be determined by experiment.

Retrospect.

That some failures would occur in the first season's experimental work in an entirely new field was to be expected, but after having obtained a definite, unquestionable profit from the use of the powdered arsenate of lead in twelve experiments out of thirteen, all made "in the dark," so to speak, and having secured an average of 71 per cent more cotton where we used the arsenate than where we did not, we feel justified in placing our results before the planters at this time. We also feel convinced that, though many failures may accompany the first attempts to employ the powdered arsenate of lead, its use will be so perfected by future experimental work that it will prove a valuable addition to the weapons which the farmer can use in his fight against the boll weevil.

MIDSUMMER APPLICATIONS NOT PROFITABLE.

The experiments already described, when studied with special reference to the degree of weevil infestation in the poisoned and non-poisoned plats, reveal the highly important fact that, while the powdered arsenate of lead can *retard* the increase in infested squares, it cannot *reduce* infestation after about the time the second summer brood of weevils reaches maturity.* In other words, "maximum infestation" (that is, destruction of practically all squares, as fast as they appear, by the weevils), is reached sooner or later, no matter how many applications of the powdered arsenate may be made or how heavily it may be applied. This point, by itself, shows that it would be useless to apply the poison during late July or during August, or to begin its use when the cotton plants have reached large size and the weevil infestation is at its height.

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*An actual reduction in the percentage of weevil infestation, by use of the powdered arsenate of lead, is not impossible during May and June, when the damage is being caused by the overwintered weevils and by the earliest maturing adults of the first summer brood. This was shown in several of our experiments.

The very small profit, or absence of profit, in those experiments where we made as many as from seven to ten applications of the poison, also shows that, from a purely financial standpoint, late applications will not pay. Their cost exceeds the value of the extra cotton produced by using the poison at that time.

During the past season we made a special experiment to find out whether any headway could be made against the weevils with the arsenate after all squares are infested and when the annual summer migration of the weevils is taking place. This experiment is described below.

EXPERIMENT AT BATON ROUGE.

Through the courtesy of Mr. R. T. Gibbens we were enabled to make an interesting, though unprofitable, experiment in one of his large cotton fields, located on the plantation owned by Mr. N. S. Dougherty, about one mile north of Baton Rouge.

On July 30th, 1909, two plats were selected near the center of a cotton field of about 100 acres. No poison of any kind had been used in this field at any time during the season. The crop had been given perfect care and at this date a fair bottom and middle crop had been set. The first bolls were commencing to open. An examination of squares on July 30th showed an average of 92 per cent of them infested by the boll weevil.*.

An application of the powdered arsenate of lead was made to the plats on July 30th, at the rate of 12½ pounds per acre, the Champion dust guns being used and extreme care taken to make the application perfect in every respect. A week later an examination of the squares showed 86 per cent infested where the poison had been applied, and 93 per cent infested in the adjoining cotton, where it had not been applied.

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*When as many as 90 per cent, or more, of the squares are infested a state of maximum infestation really exists, for the few remaining squares and forms are invariably destroyed by the weevils before they are able to develop into bolls large enough to open.

A second application was made to the same area on August 6th, at the rate of 10 pounds per acre. Examination of the squares on August 13th showed an average infestation of 97 per cent in the poisoned cotton and an infestation of 98 per cent in the non-poisoned cotton adjoining.

There is no doubt but what these midsummer applications killed some weevils, but the insects were so extremely abundant at that time, and the practical difficulties in the way of destroying them so great, that it was impossible to reduce the infestation sufficiently to permit of any additional bolls being made. In fact, during the week following the second application, the infestation in the poisoned cotton increased from 86 to 97 per cent.

This experiment demonstrated the futility of trying to attack the boll weevils with the arsenate late in the season. Protection of the so-called "top crop" by using the powdered arsenate of lead is not to be considered, for such protection is impossible.

EXPERIMENTS MADE BY PRIVATE PARTIES.

As a result of the preliminary experiments described in our Circular No. 23, a number of leading planters secured and used powdered arsenate of lead the past season, though they received no assurance from us that its use would be attended with profit.

We have endeavored to get in touch with the parties who made experiments of this kind and secure their results for the benefit of our readers. Unfortunately, the majority of farmers who used the poison failed to keep a memorandum of the exact amount used or to provide an adequate check of the same variety, whereby they could tell how much of an increase in the crop followed the use of the powdered arsenate. In fact, a number of farmers purchased the powdered arsenate and applied it to the crop "just for luck." To this day they do not know whether they lost or profited by the operation and their "opinions" on the subject are of little value as a basis upon which to offer advice to other planters.

We give below the results of private experiments that appear to have been made in a careful manner and adequate records kept as to the production of both poisoned and non-poisoned fields of the same variety.

EXPERIMENT BY PHILLIPS BROS. PLANTING COMPANY, LAKELAND, LA.

Messrs. Phillips Bros., after noting results of the first application in our own experiments on Oakland Plantation, decided to make a test of the powdered arsenate independently by applying it to several cotton fields of their own. Their experiment included two varieties, Simpkins and Toole's Early Prolific.

Simpkins Variety.

Messrs. Phillips Bros. applied powdered arsenate of lead to four fields which were planted to this variety, the four fields adjoining each other, and being separated by plantation roadways and headlands. The first application of powdered arsenate was made on June 19th at the rate of 1 pound, or a little less, per acre, Champion dust guns being used for the work. The second application was made on or about July 10th, at the rate of nearly 2 pounds per acre.

The four fields, containing a total of 28.10 acres* yielded a total of 10,844 pounds seed cotton, or 386 pounds per acre.

The two fields of Simpkins reserved as a check, without receiving any poison, were located about one-fourth mile from the poisoned plats and were on the opposite side of Bayou Ciri. The total acreage of these two plats was 9.63, and the total production was 2,278 pounds seed cotton, or 237 pounds per acre.

A difference in production of 149 pounds seed cotton per acre in favor of the poisoned cotton is seen to exist.

Toole's Early Prolific Variety.

This experiment consisted of two fields which were separated from each other by a plantation roadway. Both adjoined a small bayou. Applications of the powdered arsenate of lead were made to one of these fields on the same dates and in the same amounts as to the poisoned plats in the experiment with Simpkins, described above. The poisoned field contained 9.94 acres and produced 3,678 pounds seed cotton, or 370 pounds per acre. The non-poisoned field contained 10.13 acres and produced 4,016 pounds seed cotton, or 396 pounds per acre. A difference of 26 pounds per acre is seen to exist in favor of the non-poisoned cotton of this variety.

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*Survey made Oct. 1, 1909, by Mr. S. N. Garrett, of New Roads, La.

EXPERIMENT BY MR. ED. NEUWIRTH, WEST MONROE, LA.

The experiment made by Mr. Neuwirth was a very interesting one and it produced results that were surprising. We had some correspondence with Mr. Neuwirth early in the season, relative to the powdered arsenate of lead, and we suggested that in testing it he so arrange his experiment that he could compare the production of poisoned and non-poisoned cotton in an accurate manner. This suggestion Mr. Neuwirth adopted, and it was fortunate that he did so, otherwise his remarkable success with the powdered arsenate would have been hard to accept as correct.

Mr. Neuwirth made his experiment in a sixty-acre field in the edge of West Monroe. A turn-row divided the sixty acres into two fields of thirty acres each. Both fields adjoin the Ouachita River and both are high and well drained The land is extremely fertile, having had alternate crops of cotton and of corn and peas for many years. The soil is a very mellow sandy loam. More recently considerable truck has been grown on this land by Mr. Neuwirth. In 1900 a large number of cattle were fed in this field while being fattened for the local market and the improvement in fertility and physical condition of the soil caused thereby is still in evidence. Without doubt this land is among the finest and most fertile of cotton lands in Louisiana.

In growing the cotton crop just gathered, Mr. Neuwirth planted every other row to some truck crop or to corn, leaving cotton in every other row over the entire sixty acres. Since only the alternate rows were planted to cotton Mr. Neuwirth considers that there were really but fifteen acres of cotton in each one of the thirty-acre cuts. He has so considered it in reporting the production. There is no doubt but what the liberal space (9 feet) given to each cotton row permitted this cotton to produce far more abundantly than had it been in 4½-foot rows. At the same time this factor could hardly increase or decrease the effectiveness of the powdered arsenate of lead, nor could it alter the rate at which the poison was applied.

Between April 3 and 6, 1909, the area of sixty acres was planted to the variety "Money Maker," on beds 4½ feet apart, each row of cotton alternating with a row planted to some truck crop or to corn, as explained above. Before planting, 14 per cent acid phosphate was applied at the rate of 300 pounds per acre.

Applications of Powdered Arsenate.

Mr. Neuwirth reports his applications of powdered arsenate of lead to the 15 acres in the "poison field," in the following words:

"I commenced to apply the powdered arsenate of lead on June 11th but did not finish the applications on that day on account of rain. I used twelve pounds of the poison that day. On June 12th I finished poisoning the cut and again went over that which was poisoned the day before, as I thought the rain had undone my work of the 11th. In these two applications I applied two pounds of the arsenate per acre, or thirty pounds to the fifteen acres.

"June the 15th I poisoned again and used fifteen pounds. On the 16th it rained. On the 17th I poisoned again—used fifteen pounds more. That night it rained, but not finding any weevils after that poisoning I did not poison again until June 24th.

"June 24th I used thirty pounds of the poison, or two pounds per acre. At each poisoning I used the Champion dust gun bought in Baton Rouge."

The crop was cultivated by day hands, plenty of labor being available on account of the proximity of Monroe. Mr. Neuwirth's fields, both poisoned and non-poisoned, received perfect cultivation and the fallen infested squares were frequently picked up in both.

Square Infestation.

We have no data upon the relative infestation of squares in the poisoned and non-poisoned fields except that secured by Mr. C. W. Flynn, Assistant Entomologist, who, at our request, visited Mr. Neuwirth's place on August 4th. Mr. Flynn found 22 per cent of the squares infested in the fifteen-acre field to which the arsenate had been applied, and an average of 41 per cent infested in the non-poisoned fifteen acres. Mr. Flynn also noted that "the bottom and middle crops in both plats were very good and there seemed to be a prospect for a good half-bale per acre."

The square infestation in both plats on August 4th was exceedingly low for that season of the year. It should be mentioned, however, that Mr. Neuwirth cut and burned all cotton plants on the place in the latter part of October, 1908. Mr. Neuwirth himself says that boll weevils were exceedingly abundant in the spring of 1909 and that he noticed thousands of them in lumber piles that were taken down on adjoining premises. It is not impossible that Mr. Neuwirth was mistaken as to the identity of the weevils found in this lumber. Lumber is not a favorite hibernating place for the boll weevil and, on the other hand, weevils closely resembling the boll weevil are often found in such situations in enormous numbers.

Production.

On November 12th, 1909, Mr. Neuwirth wrote us as follows regarding the production of the two fifteen-acre fields of cotton:

"Seed cotton picked from fifteen acres poisoned with powdered lead arsenate:

"Week ending August 31	1,485 lbs.
"Week ending September 8	2,800 lbs.
"Week ending September 14	2,750 lbs.
"Week ending September 27	3,650 lbs.
"Week ending October 9	3,220 lbs.
"Week ending October 16	5,550 lbs.
"Week ending October 23	1,460 lbs.
"Week ending October 30	712 lbs.
"Finished November 6	297 lbs.
"Total	21,924 lbs.

"Seed cotton picked from fifteen acres not poisoned:

"Week ending September 4	800 lbs.
"Week ending September 8	1,065 lbs.
"On 9th	930 lbs.
"On 10th	320 lbs.
"Week ending September 18	4,715 lbs.

"Week ending September 30	4,155 lbs.
"Finished picking October 9	410 lbs.
"Total	12,395 lbs.

"The above is a true statement.

(Signed) ED. NEUWIRTH,
"Manager, Cotton Port Plantation."

According to Mr. Neuwirth's figures the production of the cotton poisoned with powdered lead arsenate was 1,461 pounds seed cotton, practically one bale per acre, or better. The production of the corresponding fifteen acres, not poisoned, was 827 pounds seed cotton per acre. This leaves a balance of production of 634 pounds per acre in favor of the poisoned field.

It hardly seems conceivable that such a great increase in the crop could follow the use of so small an amount of arsenate as 6 pounds per acre, applied in four applications. We frankly admit, however, that after closely questioning Mr. Neuwirth, as well as several parties who have personally visited the experiment, and examined the two fields, we can find nothing—aside from the use of the powdered arsenate of lead—which could have caused the increase in production in the poisoned field.

On a preceding page we called attention to the fact that cotton properly fertilized, on good cotton land, could be expected to benefit more from the applications of powdered lead arsenate than that on poor or unfertilized land. Mr. Neuwirth's land is, without doubt, extremely fertile, well drained, and admirably adapted to the production of a large crop. In this may possibly be found a partial explanation for the success which he reports.

Mr. Neuwirth also used the powdered arsenate of lead on his main crop of 120 acres. Under date of November 12th he wrote us:

"Am only sorry that I did not poison the fifteen-acre check field also, for my entire poisoned crop, other than the experiment, turned out very satisfactorily—98 bales from 120 acres."

EXPERIMENT BY MR. WM. SWIFT, MANSURA, LA.

Mr. Swift made an experiment with the powdered arsenate of lead, applying it to one-half of a small field of Cleveland Big

Boll cotton and leaving the other half non-poisoned to serve as a check. Each half of the field contained 1.36 acres, as determined by measurements made by Mr. W. R. Messick, Parish Surveyor of Avoyelles Parish.

Two applications of the powdered arsenate of lead were made, the first on June 12th at the rate of 3½ pounds per acre, and the second on June 29th at the same rate. Mr. Swift used the Champion dust gun for doing the work.

Mr. Swift reported the production of the two plats as follows:

Poisoned plat, 1.36 acres	448 lbs. seed cotton
Non-poisoned plat, 1.36 acres	548 lbs. seed cotton

The balance of production is seen to be apparently in favor of the non-poisoned plat. However, on investigation, we find that the half of the field to which the arsenate was applied had been badly washed during previous seasons and much of the top soil had been washed away. Only a partial stand was secured in this half of the field. Under the circumstances, therefore, it is remarkable that the poisoned half produced as much cotton as it did.

EXPERIMENT BY MR. E. Z. GAUTHIER, COTTONPORT, LA.

Mr. E. Z. Gauthier, of Cottonport, Avoyelles Parish, reports making one application of the powdered arsenate of lead, on July 7th, to King and Simpkins cotton, at the rate of two pounds per acre. The application was made by dusting the arsenate from a sack. Mr. Gauthier states that he could see no difference in the production of the poisoned and non-poisoned cotton, but did not keep an accurate record of weights and areas.*

EXPERIMENT BY MR. D. W. PIPES, DOSS, LA.

Mr. Pipes reports having made three applications of powdered arsenate; on June 28th, July 15th and July 25th. Each application was at the rate of 5 pounds per acre. A Champion dust gun was used. The cotton experimented on was of the Simpkins variety, fertilized with 400 pounds per acre high-grade fertilizer.

The poisoned cotton produced 1,595 pounds per acre and the non-poisoned 1,510 pounds per acre.

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*We have called attention on a preceding page to the futility of applying this poison by dusting it from a sack. It is necessary that the poison be *forced* into the buds with a powerful blast of air.

This experiment was somewhat complicated by the fact that 2 pounds per acre of Paris green were applied on August 2nd for destruction of the boll worms, which were exceedingly abundant.*

Under date of November 25, 1909, Mr. Pipes kindly furnished us with the above facts relative to the experiment, and commented on it as follows:

"I lay more importance to fertilizer and work than to any poison that can be used. This (the experiment) was a pet patch and was worked very intensively. Other cotton on which I used only 200 pounds of fertilizer per acre and did not work quite as well made an average of a little less than one-half of a bale per acre. All of our cotton was infested with both the weevils and the boll worms, the latter doing more damage than the former for awhile in August. Until the hot blast arrived they ate the green bolls that would have opened."

EXPERIMENTS BY MR. W. D. CLAYTON, WASHINGTON, MISS.

Mr. Clayton made a number of interesting experiments with the powdered arsenate of lead on boll weevils, in cages. Under date of December 2, 1909, he reported on them as follows:

"Livingston, Ala., Dec. 2, 1909.

"The experiments that I conducted at Washington, Miss., in the spring were about as follows: As you know, the weevils came out of hibernation early and in large numbers. I dusted over the young cotton plants the dry arsenate of lead from a sack; then I caught a large number of weevils and placed them in a cage, which was placed over one stalk of cotton which had been dusted. I repeated this experiment in several fields at different times, and in each instance after 36 hours there were no live weevils in the cage. Of course I could not tell if the number of weevils in the field at large were reduced to any appreciable extent, but those placed in the cages were dead after 36 hours, and I noticed the bud leaves of the cotton stalks, in the cages, were full of little holes, indicating that the weevils had eaten some cotton and the poison, enough to kill them. The powder was applied at about three pounds per acre. * * *

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*Powdered arsenate of lead could have been used to better advantage for the destruction of the boll worms. The arsenate would have cost less, would have killed the boll worms as effectively as Paris green and would not have stopped the cotton from "making."

"The method of applying arsenate of lead through a sack, or dusting it on the plants, is not a satisfactory method, because it is slow and it does not penetrate into the crown of the stalk.

"If these results can be of any service to you, you are at liberty to use them, but remember that as it is one year's result they may not be as conclusive as they might be, but they point to the fact that the arsenate of lead * * * when applied correctly and at the right time will surely destroy some weevils; whether the number destroyed will justify the use and the expenditure for the poison is a question that I am not able to answer. Yours very truly,

(Signed) "W. D. CLAYTON."

OTHER EXPERIMENTALISTS.

We have heard from quite a large number of other planters, all of whom applied the powdered arsenate of lead *by dusting it onto the cotton plants from a sack.* There is no necessity for taking up space detailing their experiments, *for they were all failures.* In the present circular we have repeatedly called attention to the futility of trying to apply the arsenate in this manner.

OPINIONS OF PRACTICAL PLANTERS.*

We have requested a number of planters who have been in close touch with our experimental work during the season, or who have performed experiments of their own, to give us their opinions on the powdered arsenate of lead as a practical boll weevil poison. These opinions follow:

Dr. Gordon Morgan, Woodside, La.

"After carefully reading the write-up on your experiment† with powdered arsenate of lead in killing the boll weevils on my place this year, I find it absolutely correct. I am thoroughly convinced beyond any doubt of the efficacy of this poison in combating the weevil. I believe, by selecting well drained sandy land, destroying the cotton stalks in early fall, adopting intensive cultivation, a selected early variety of cotton and the application of powdered arsenate of lead as you direct, a full crop of cotton is possible.

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*In event any of our readers address the planters whose names are here given we trust they will not forget to enclose a stamped and addressed envelope for reply. It is not our desire that the men who assist (without pay) in these experiments, and who freely give their experience for the benefit of fellow planters, should be annoyed by needless letters and inquiries.

†Refers to the "Woodside Experiment." For description see page 287.

"The tenant who cultivated the experimental plats for you is so impressed with the results that he wants to plant a full crop of cotton another year.

(Signed) "GORDON MORGAN."

Mr. A. R. Roach, Mansfield, La.

"Mansfield, La., Dec. 1, 1909.

"After having used the powdered arsenate of lead on ten acres of cotton the past season, I found that it increased the yield so much that I expect to use it on my entire plantation next year. I would like to state, further, that the poisoned plat was in full bloom and making cotton as late as the 26th of August. On the non-poisoned cotton I did not see any blooms later than August the 5th.

"The yield was so much greater in the poisoned than in the non-poisoned cotton that I was persuaded it was the poison that increased the yield. I believe that quite a number of my neighbors who have investigated this experiment have been fully convinced that the powdered arsenate of lead is beneficial and are going to use it another year.*

(Signed) "A. R. ROACH."

Phillips Bros.' Planting Co., Ltd., Lakeland, La.

Mention has already been made of the experiments which we conducted on the Phillips Bros.' Planting Co.'s plantation, and of the two experiments made by them independently. Under date of November 24th, 1909, they wrote as follows:

"Referring to experiments that were conducted by your Commission on our plantation this year beg to say that in our opinion the use of powdered arsenate of lead applied to cotton in its early stages, that is, when it is beginning to bud, will we think destroy a lot of the over-wintered weevils, and should climatic conditions be favorable during the early spring and with dry weather in July and August, we think the use of it will show a decided profit.

"However, with a cold, late spring and a rainy summer we are frank in saying that we do not consider that any cotton can be made.

"Yours very truly,

(Signed) "PHILLIPS BROS. PLANTING CO., LTD.,
"Per N. P. PHILLIPS."

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*A full account of Mr. Roach's experiment will be found on page 299 of this Circular.

Mr. Jas. S. Fleming, Natchez, Miss.

Under date of November 23, 1909, Mr. Fleming wrote us, in part, as follows:

"The rains were so continuous at the time the powdered arsenate of lead should have been put on that we were unable to use it until it was almost too late; the cotton was then commencing to square. This was on a river plantation (swamp land) and we made 220,000 pounds lint on between 1,000 and 1,200 acres.

"In the hills, we made one application upon a patch of cotton of about 25 acres and made ten bales averaging 450 pounds each.

"The rest of the property did not do nearly so well, but was not worked as well. I believe that two applications of the powdered arsenate of lead, properly applied, and at the right time, will be beneficial; just to what extent I am unable to say without further trial."

Mr. Ed. Neuwirth, West Monroe, La.

On page 318 we gave a full account of Mr. Neuwirth's experiments with the powdered arsenate of lead and also quoted him quite extensively. Mr. Neuwirth's opinion of the poison is tersely expressed in the following sentence, taken from one of his recent letters:

"I will plant 150 acres in cotton next year and fight the weevil on the same plan."

A number of planters and business men of Monroe kept Mr. Neuwirth's experiment under observation throughout the season and some of these gentlemen have kindly expressed their views for publication. The opinions of Messrs. Morris, Platt and Goldman on this experiment follow:

W. L. Morris, West Monroe, La.

"West Monroe, La., Dec. 1, 1909.

"I have had the cotton crop on Cotton Port Plantation under observation the whole season, and I consider that the use of powdered arsenate of lead, and picking up squares, was the cause of a good crop being produced on said plantation.

"I have taken quite an interest in the experiments, and think the raising of cotton in the boll weevil section has been largely solved.

"Furthermore, I used it myself in a small way, and the yield was doubled by its use on same land with a turn row between.

(Signed) "W. L. MORRIS."

J. W. Platt, Jr., Monroe, La.

"I have on several occasions during the year of 1909 visited the Cottonport Plantation, from June 1st to August 30th, and as far as my observation can determine I conscientiously believe that the experiment that I observed between poisoned cotton on fifteen acres and non-poisoned cotton was fair and I have come to the conclusion that the only solution of the boll weevil proposition would be to poison cotton in the chopping stage, or say from May 15th to June 20th, up to the time when cotton puts on squares. I furthermore believe that the Cottonport crop was made by quick ploughing, picking up squares and judicious fertilization, this, certainly, in connection with the powdered arsenate of lead poison referred to above.

(Signed) "J. W. PLATT, JR.,
"Monroe, La., Dec. 1, 1909. Cotton Buyer."

S. Goldman, Monroe, La.

"Monroe, La., Nov. 30, 1909.

"I have carefully observed the cultivation and growing of the cotton crop on the Cotton Port Plantation, managed by Mr. Ed. Neuwirth this year, and readily discovered that he made more than double the amount of cotton on the portion where he used powdered arsenate than on the same quality of land where he did not use it.

"In my opinion it is a great success, and every farmer ought to follow this example and by this means make a crop regardless of the pest we have to contend with.

"Respectfully,
(Signed) "S. GOLDMAN."

Mr. W. L. Shaw, Shaw, La.

"My plantation manager, Mr. Fred W. Eberhart, noticed a big difference between the poisoned and non-poisoned fields. I believe it will pay to apply this poison on cotton if done in due time and properly put on. It will not do in very large or rank cotton where the cotton is close enough to lap in the rows or drills. If I plant any cotton this coming year, will use this poison, powdered arsenate of lead."*

Mr. F. W. Eberhart, Shaw, La.

Mr. Eberhart was Plantation Superintendent on Mr. Shaw's plantation, where our experiments were made, and he had the experiments under observation practically every day from the time the seed was planted until the crop was gathered. Mr. Eberhart kept the weights of all cotton picked in the two experiments at Shaw and was accordingly in a position to draw safe conclusions as to what was accomplished by the powdered arsenate of lead. Mr. Eberhart wrote as follows, under date of November 29, 1909:

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*Mr. Shaw's statement has reference to our experiments made on his plantation, which are fully described on preceding pages.

> "In regard to powdered arsenate of lead as a boll weevil poison will say that I made a close study of it and it has been proven to my entire satisfaction that by applying same properly it produces double the amount of cotton and that by using it, together with an early variety, and improved implements, one can still make cotton profitable in a boll weevil district.
>
> Respectfully,
>
> (Signed) "F. W. EBERHART."

WHEN APPLICATIONS CAN BE COMMENCED TO BEST ADVANTAGE.

In Circular No. 23 we called particular attention to the important point that all boll weevils are not out of hibernation at the time the first squares appear upon the plants, and to the fact that there is neither necessity nor economy in trying to poison the weevils while the cotton is still too small to put on squares.* This is true for the very simple reason that the boll weevils cannot reproduce their kind until the first squares appear and for the further reason that many of the weevils, which come out of hibernation real early in the spring, die of old age before any squares are available. The greatest number of weevils can be killed when the cotton plants are in the budding stage, just before squaring. (See Figure 4). They can be killed at this time just as well as earlier in the spring. The sensible thing to do, therefore, is to let the weevils have their own sweet way in the small cotton, and then make a determined attack on them at the time when the majority of plants are in the budding stage. Since never more than 60 per cent of the plants in a field are in this particular stage of growth at any one time the best rule for the planter to follow is to make his first application *upon the very day that he can find the first square in his cotton field.* From then on, until all plants have passed the budding stage and have put on

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*See Circular No. 23, page 32. Further confirmation of this fact was secured in the experiments made at Mansura, 1908-09, in which it was found that the last of the weevils did not leave hibernation until June 29th. The reader should also consult Circular No. 31, pages 184 to 187 and pages 210 to 214. Both Circulars may be had (free) on application to the "State Crop Pest Commission, Baton Rouge, La."

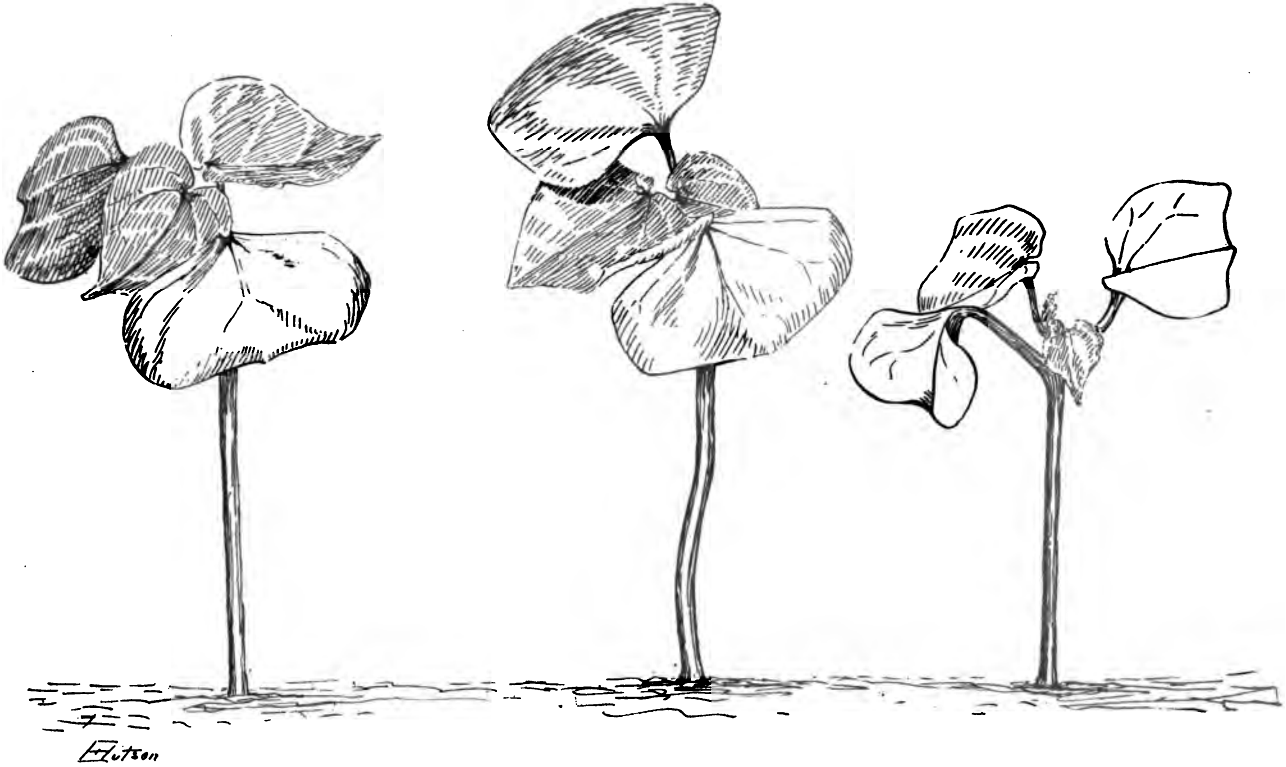

FIG. 3.—Cotton plants too small for the economical application of powdered arsenate of lead. Attempting to poison the boll weevils upon cotton as small as this is useless and unnecessary labor, because the weevils cannot reproduce their kind until squares appear upon the plants, and there is no economy in poisoning the weevils which die of old age before squares appear. Those hibernated weevils which DO live until the plants reach the budding stage, just before squaring, can be poisoned as readily then as they can when the cotton is as small as this.

squares, is the critical time for the boll weevils, and the time of opportunity for the farmer.

If the poisoning be neglected at this stage there will be little use of trying to make up for it by subsequent applications.

In the light of our present knowledge the best results will follow from about five applications, made from 5 to 7 days apart, the first one being made at the time of appearance of the first square in the cotton field.

It must be remembered that the over-wintered weevils continue to come from their hibernating quarters and infest the fields for a considerable time after the first squares appear. All of these "late" weevils cannot be destroyed with the arsenate, but the infestation which they produce can be greatly retarded by applications of the arsenate made in the proper manner. The object of the third, fourth and fifth applications is to hold back the infestation as much as possible, after the greatest possible number of weevils have been killed while the cotton is in the budding stage.*

It must also be remembered that the profit derived from using this new poison is dependent upon the farmer giving full attention to every other detail necessary to the production of a good crop, such as early fall destruction of the cotton plants, early planting, proper use of fertilizers, early varieties, thorough cultivation, etc. (See pages 305 to 312.)

If the fallen infested squares be picked up and burned—or better still, caged as directed in our Circular No. 20 (which see, page 6)—in addition to the poisoning with powdered arsenate of lead, still greater good will result. The planter must adopt *every* practical measure for destroying the weevils and outwitting them. He cannot depend upon any one step, such as using the powdered arsenate, and neglect the others.

Even if all the foregoing directions are carefully followed, it will avail the planter nothing whatsoever, unless he applies the poison in the proper manner and with the proper machinery. We frankly predict many failures. Poisoning the boll weevils with profit is not easy, and the planter who undertakes it without first thoroughly understanding the principles upon

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*In view of what we have learned during the past season's experiments, our statement under Fig. 3, page 36, of Circular No. 23, requires modification.

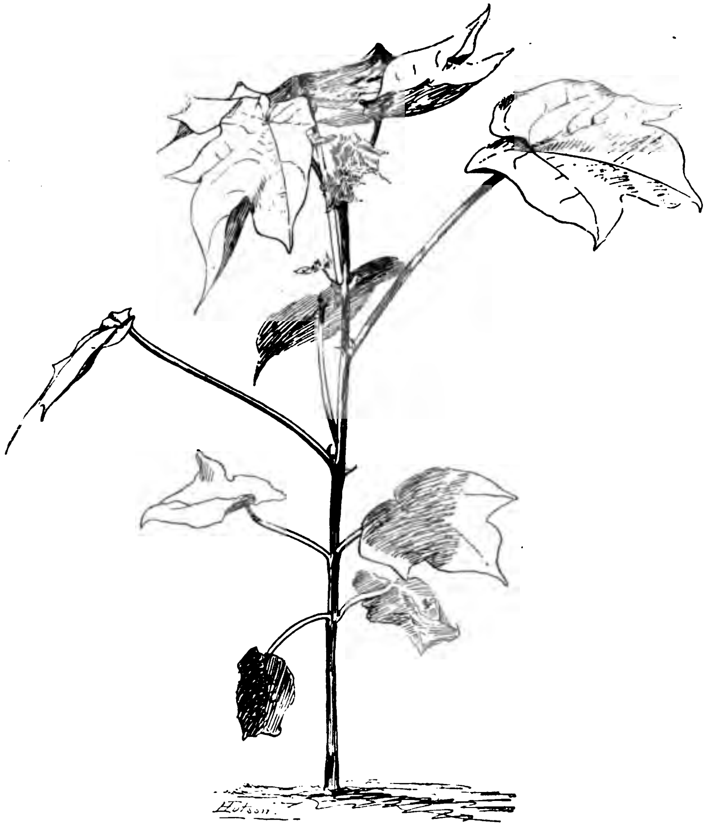

FIG. 4.—Cotton plant in the "budding" stage. Notice the terminal whorl of small leaves in which the boll weevils feed in preference to feeding on the foliage. It is at this stage in the plant's growth that the applications of powdered arsenate of lead are commenced. By the time the plant has reached this stage many hibernated weevils have died of old age and no squares have been present in which a new generation could be produced. The powdered arsenate must be *forced* into the terminal bud with a dust gun of the proper kind so it will kill such weevils as may feed there.

which success is based, or who does the work in a shiftless, indifferent manner, will reap only failure.

HOW APPLICATIONS MUST BE MADE.

Our success in poisoning the weevil with the powdered arsenate of lead is based upon two things:

First, to the fact that the powdered arsenate of lead does not contain soluble arsenic; therefore it cannot injure the cotton, no matter how heavily it is applied. If any is found which *does* contain soluble arsenic and does injure the cotton plants, it will be the manufacturer's fault, not ours.* A properly made insecticide is the first requisite for success, and it has been to the perfection of this powdered arsenate of lead that we have devoted our constant efforts for the past four years.

In the second place, the powdered arsenate of lead *must* be applied to the cotton with a powerful current or blast of air which will *force* the poison in between the small leaves which make up the terminal "buds" (not squares) on the ends of the main shoots and on the ends of the fruit limbs. It is useless to dust or sift the poison on from any device made of cloth or sacks. Poisoning the boll weevil is a far more difficult task than poisoning the cotton worm and is based on entirely different traits in the two insects, as well as on important differences in their anatomy and methods of feeding.

If we were able to do so, we would paint a large signboard in every cotton field, bearing, in big, red letters, the words: "Do not use a sack." There is no point upon which we can lay more emphasis than on this.

The only machine which we know of, with which the applications can be properly made, is a small dusting machine, known as the "Champion" dust gun.† This machine consists of a reservoir for holding the powdered arsenate, a fan driven by hand and a nozzle, or outlet pipe, which can be directed by the operator so that the poison will be forced into every bud. In use, the machine is strapped to the operator's waist, his right hand operates the fan, while his left hand directs the outlet pipe to each bud and square in succession. A simple device regulates the amount of poison expelled. The manner of using this machine is illustrated in figure 2.

The mere purchase of one of these machines and the placing of it in the field in the hands of a plantation laborer is not sufficient. It is easily possible to distribute a ton or so of arsenate with the machine, without doing a particle of good. In the first place, the handle of the machine must be turned at a fair rate of speed so that the current of air from the nozzle will be *very* strong. In the second place, the operator must be careful to hold the nozzle so that the current of air will *force* the poison into the buds. Merely pointing the machine out over the cotton row and allowing the arsenate to *settle* on the plants will do no good. In the third place, the powdered arsenate must be put on in liberal quantity.

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*It is the presence of soluble arsenic in Paris green that has caused this poison (Paris green) to be such a dismal failure when tried against the boll weevil.

†Obtainable from Leggett & Bro., 301 Pearl St., New York, or from Doherty Hardware Co., Baton Rouge, La. We have no doubt that other firms will place similar machines upon the market if a demand for them arises.

HOW MUCH TO APPLY PER ACRE.

When the plants are in the budding stage, at which time the first application is made to best advantage, the proper amount to use is from 2 to 2½ pounds per acre. This is about the largest amount that can be applied at this time without waste. The farmer is likely to be deceived in the amount of poison being applied. Therefore, he should not *guess* at the amount, but should weigh out the poison and use it on a measured area until he finds that he is using the correct amount. At the time of the second application, practically the same amount of the powdered arsenate is used. Succeeding applications require more and more of the powder because of the fact that the plants are increasing rapidly in size and the number of branches, buds and squares is also increasing. By the time the fifth application is reached not far from five to seven pounds per acre will be required at each application. With each succeeding application, also, more time is required for doing the work. At first sight, many farmers will say that too much time is required and this may tend to disastrous haste. To such, we have nothing to say except that "what is worth doing at all is worth doing well." Better not spend money in arsenate and machinery if they are not to be used carefully and intelligently. Our own experiments show that success follows only on the heels of extremely careful work in making the applications and they show, at the same time, that *carefully* made applications are the only ones that *pay*. We believe most of the farmers are growing cotton for the profit there is in it; not for fun or for the purpose of merely "saving time."

CAUTION.

It must be remembered that the powdered arsenate of lead is an arsenical poison and is as dangerous to human life and to the life of work animals as it is to boll weevils. Precautions against accidental poisoning must be taken accordingly. Keep all supplies of the powdered arsenate in a safe, dry place, under lock and key. Have it properly labeled, as it resembles flour to a dangerous degree.

In cultivating cotton fields where it is used, do not fail to muzzle the work animals so they cannot eat of the poisoned foliage.

Do not allow animals to graze on the headlands and roadways in fields where the poison is used.

Do not plant hills of corn in the cotton field, and then wonder why cattle and horses are killed when the corn is fed to them.

Do not "fool" plantation negroes by telling them that the powdered arsenate is harmless. Advise them of its true nature, explaining at the same time that if they use proper care and common sense there will be no danger connected with using it.

In short, exercise the same precautions in handling and using this poison as would be used with Paris green or other deadly poison.

A FEW "DON'TS."

Don't increase your cotton acreage on the assumption that you are going to be able to poison the weevil with the degree of success that has attended our experiments. Remember that it took us four long years to learn how to do it, and we made many, many failures in the learning. It is not likely that you will acquire the same knowledge and experience in a few hours' time.

Don't put your entire farm in cotton and buy all your supplies. No matter what the price of cotton, or how much of it you grow, you can also produce your own meat, corn, hay, milk, butter and vegetables *for less money than you have to pay the other fellow to do it for you.* The northern farmers are getting rich growing corn and hogs to feed the poor southern farmer while he "raises cotton."

Don't try to grow cotton on land that is totally unadapted to cotton culture under boll weevil conditions and then expect the powdered arsenate of lead to make your crop for you. It can't do the impossible.

Don't let your cotton plants stand in the field until the middle of the winter and then expect the powdered arsenate of lead to take care of the millions of over-wintered weevils the next spring. A mule can pull only so big a load: the powdered arsenate can kill only so many weevils.

Don't follow the wrong line of reasoning and think that, because some of the weevils can be killed by the arsenate, that you can plant your crop late and then poison to kill the over-wintered weevils. It won't work, for the weevils will get your crop in spite of all the poison you can put on it.

Don't invest a lot of money in powdered arsenate of lead the first year you try it. Make a careful test on a small part of your cotton acreage and "get the hang of it" before risking a big investment. It's no easy matter to make a success.

Don't try to use powdered arsenate of lead at all without first studying this bulletin, and the references in it, and being *sure* that you understand the *principles* upon which successful poisoning of the boll weevil is based.

Don't try to apply the powdered arsenate of lead by dusting it onto the cotton plants from a sack. Buy both the poison and the proper machinery, or don't buy either one.

Don't turn a plantation negro loose in a cotton field with a dust gun and a can of arsenate and let him go his own way. The work must be done *right.* "White folks," as well as "niggers," sometimes do the work improperly.

Don't leave the powdered arsenate of lead where children can get at it. It is deadly poison and is easily mistaken for flour or sugar.

Don't fail to properly label all cans and other receptacles containing it, so as to give ample warning of its dangerous nature.

Don't work live stock in a field where the arsenate has been used without muzzling the animals to keep them from eating the poisoned foliage.

Don't allow animals to graze on headlands and turn-rows in fields where the arsenate is used.

THIS BOOK IS DUE ON THE LAST DATE
STAMPED BELOW

BOOKS REQUESTED BY ANOTHER BORROWER
ARE SUBJECT TO RECALL AFTER ONE WEEK.
RENEWED BOOKS ARE SUBJECT TO
IMMEDIATE RECALL

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